U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
FEDERAL HIGHWAY ADMINISTRATION

Method for Examination and Documentation of Basic Information and Metadata from Published Reports Relevant to the Study of Stormwater Runoff Quality

Open-File Report 99-254

A Contribution to the
NATIONAL HIGHWAY RUNOFF DATA AND METHODOLOGY SYNTHESIS

U.S. Department
of Transportation

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U.S. Department of the Interior
U.S. Geological Survey

Method for Examination and Documentation of Basic Information and Metadata from Published Reports Relevant to the Study of Stormwater Runoff Quality

By Shannon G. Dionne, Gregory E. Granato, *and* Cameron K. Tana

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Northborough, Massachusetts
1999

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PREFACE

Knowledge of the characteristics of highway runoff (concentrations and loads of constituents and the physical and chemical processes that produce this runoff) is important for decision makers, planners, and highway engineers to assess and mitigate possible adverse-impacts of highway runoff on the Nation's receiving waters. In October, 1996, the Federal Highway Administration and the U.S. Geological Survey began the National Highway Runoff Data and Methodology Synthesis to provide a catalog of the pertinent information available; to define the necessary documentation to determine if data are valid (useful for intended purposes), current, and technically supportable; and to evaluate available sources in terms of current and foreseeable information needs. This paper is one contribution to the National Highway Runoff Data and Methodology Synthesis and is being made available as a U.S. Geological Survey Open-File Report pending its inclusion in a volume or series to be published by the Federal Highway Administration. More information about this project is available on the World Wide Web at http://ma.water.usgs.gov/fhwa/runwater.htm

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

Method for examination and documentation of basic information and metadata from published reports relevant to the study of stormwater runoff quality

by Shannon G. Dionne, Gregory E. Granato, *and* Cameron K. Tana

Abstract

A readily accessible archive of information that is valid, current, and technically defensible is needed to make informed highway-planning, design, and management decisions. The National Highway Runoff Water-Quality Data and Methodology Synthesis (NDAMS) is a cataloging and assessment of the documentation of information relevant to highway-runoff water quality available in published reports. The report review process is based on the NDAMS review sheet, which was designed by the USGS with input from the FHWA, State transportation agencies, and the regulatory community. The report-review process is designed to determine the technical merit of the existing literature in terms of current requirements for data documentation, data quality, quality assurance and quality control (QA/QC), and technical issues that may affect the use of historical data. To facilitate the review process, the NDAMS review sheet is divided into 12 sections: (1) administrative review information, (2) investigation and report information, (3) temporal information, (4) location information (5) water-quality-monitoring information, (6) sample-handling methods, (7) constituent information, (8) sampling focus and matrix, (9) flow monitoring methods, (10) field QA/QC, (11) laboratory, and (12) uncertainty/error analysis.

This report describes the NDAMS report reviews and metadata documentation methods and provides an overview of the approach and of the quality-assurance and quality-control program used to implement the review process. Detailed information, including a glossary of relevant terms, a copy of the report-review sheets, and report-review instructions are completely documented in a series of three appendixes included with this report. Therefore the reviews are repeatable and the methods can be used by transportation research organizations to catalog new reports as they are published.

INTRODUCTION

The highway-runoff research community recognizes that a readily accessible archive of information and data is necessary to make informed highway-planning, design, and management decisions. The data and information must be valid--useful for the intended purpose, current--representative of highway-runoff quality today and for the foreseeable future, and technically defensible--presented with sufficient information to repeat the experiment and to verify that the methods used and the results reported are complete, correct, and meet regulatory requirements for reporting environmental data (Bank, 1993; Transportation Research Board 1996, 1997; Granato and others, 1998). Studies of highway-runoff quality and its effects on receiving waters and the environment usually begin with a search of pertinent literature. Information about the existence, availability, and quality of reports with pertinent information and data, however, can be difficult to obtain. Therefore, the National Highway Runoff Water-Quality Data and Methodology Synthesis (NDAMS) is needed to catalog existing literature pertinent to the study of highway-runoff water quality and its effects on receiving waters and the environment, and to assess the suitability of the existing information to meet State, regional, and national water-quality information needs. The Federal Highway Administration (FHWA) and the U.S. Geological Survey (USGS) are carrying out this study with input from members of the Transportation Research Board (TRB) and professionals in numerous State Departments of Transportation (DOTs) that are active in highway-runoff-quality research.

Different aspects of urban- and highway-runoff quality have been the subject of numerous studies since the 1960's by many State DOTs, the FHWA, the U.S. Environmental Protection Agency (USEPA), the USGS, other State and Federal agencies, and different universities (Shaheen and Boyd, 1975; Gupta and others, 1981; Harrop, 1983; Smith and Lord, 1990). The purposes for these programs have ranged from simple monitoring studies designed to meet legal requirements to complex scientific studies designed to provide research in runoff-water chemistry, runoff processes, or the design of best management practices (BMPs). When the first studies of highway-runoff quality began, the regulatory framework and the science, engineering, and technology needed for the study of runoff quality were not well developed. Over the last three decades, regulations, theories, methods, and requirements for report documentation have changed and continue to change with time. Also, purposes for which water-quality data are needed and used, as well as the types of water-quality data collected, differ greatly. Thus, data collected for one purpose are not necessarily transferable to other purposes. If data from different sources are to be aggregated, existing data need to be selected and used carefully. It is imperative that available data are comparable and were produced with comparable sample collection and analysis methods if they are to be used in a decision-making process (Childress and others, 1987).

In the past, when existing highway-runoff data and information were assembled for quantitative analysis, problems with accuracy, consistency, and documentation were noted. For example, Driscoll and others (1990a,b) detected data-entry errors, inconsistent documentation, and unexplained outliers among more than 31 data sets from 11 different states used to build a predictive highway-runoff-quality model. Thomson and others (1996) found unresolved problems, including data-entry errors, in an otherwise useful data set. Most recently, Dupuis and others (1999) noted that several studies were not useful to support valid, current, and technically defensible conclusions about the effects of bridge deck runoff on receiving waters on a national scale because of insufficient documentation of site characteristics, methods, and (or) data quality. Therefore, before data are accepted, incorporated, and distributed by an official source, it is necessary to establish and define criteria for documentation of basic information, acceptable uncertainty, and required quality assurance and quality control to ensure that a given data set will meet the various data-quality objectives for different highway-runoff information needs (Granato and others, 1998).

Purpose and Scope

This report describes and documents the NDAMS report review process in the text and in a series of appendixes. The body of the report explains the philosophy behind the NDAMS review process, provides a brief description of this review process, and describes the quality-assurance and quality-control measures used to manage the review process. A glossary (appendix 1) provides general definitions pertinent to the review process, specific terms used in the review sheets, and terms used to categorize data elements. The standard forms used for the reviews are documented in appendix 2. Detailed instructions for evaluating each element in the review forms is documented in appendix 3. Therefore, the reviews are repeatable and the methods can be used by the FHWA, State DOTs, and (or) other transportation research organizations to catalog new publications as they are published.

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BACKGROUND

Reliable information is needed to characterize and predict concentrations, loads, and potential effects from constituents of highway-stormwater runoff and to provide information to develop BMPs to manage runoff at point, local, watershed, regional, and national scales. The NDAMS report-review process is designed to provide decision-support criteria by assessing and documenting information about published data and data-collection procedures to evaluate the availability and applicability of this information for addressing current and future highway-runoff-quality information needs. The process is designed with respect to technical issues for current and future information needs of highway managers, practitioners, and researchers.

The NDAMS review process is designed on the premise that the data and information in published reports must be documented sufficiently to support their continued use in decision-making processes before an effort is made to enter measured water-quality values in a national data base to be used for interpretation, design, and decision making by highway professionals. This report-review process is also designed on the premise that a systematic review of available reports will: (1) indicate whether available information meets current data-quality standards, (2) identify problems such as gaps in areal coverage, or changes in source chemistry and, (3) identify unresolved information needs from among the published literature (Granato, 1997; Granato and others, 1998).

The NDAMS report-review process is being used to evaluate available information from results of investigations published by State DOTs, the FHWA, the USEPA, the USGS, and other organizations within and outside the United States. The USGS is cataloging the availability of data and report documentation within a framework designed to meet these information needs.

APPROACH

A detailed review of the documentation of data pertinent to the study of highway runoff is necessary to record whether it sufficiently defines pollutant characteristics, loadings, and effects from highway-runoff quality on a regional and (or) national scale. The review process is designed to determine whether available data and the methodologies used to collect this data are documented sufficiently for combination in a national data base of highway-runoff data and that this information is sufficiently robust to withstand a technical challenge based upon current data-quality standards. The reviews provide a way to summarize data quality from a variety of reports into a standard format and to facilitate entry into and retrieval from a data base to facilitate evaluation and use of the metadata. The review process, however, is not designed for a predetermined set of data-quality evaluation criteria, but rather to provide the metadata necessary to evaluate the suitability of each report to meet information needs with respect to data-quality objectives defined by regulators or decision makers who are involved with a given highway-runoff-quality problem.

The NDAMS review sheet and the review process are designed to document data and information that are needed to determine whether each report reviewed meets various criteria to establish that published results are valid, current, and technically defensible. The NDAMS report review sheet (appendix 2) is based on input from the FHWA, the Intergovernmental Task Force on Monitoring Water Quality

(ITFM), State DOTs, and regulatory agencies, to record results of a systematic evaluation of available published reports considered to be relevant to the study of highway runoff. The NDAMS review-sheet instructions (appendix 3) should provide enough information for someone with a scientific or engineering background and a familiarity with water-quality, highway-, and stormwater-runoff issues to do a complete and consistent review. The NDAMS review sheet and the review process, however, often require an interpretive assessment of the publication being reviewed because the detail, format, and expression of information provided vary greatly among the reports being reviewed. In these instances, the reviewer must translate published descriptions of study design, objectives, methods, equipment, and results into standard responses so that different sources of published information can be evaluated using criteria that meet intended data-quality objectives. Granato and others (1998) describe information requirements and data-quality criteria that are necessary for a national evaluation of highway-runoff quality. Glossaries A, B, and C (appendix 1) are included to help standardize the review process by defining general terms, the data-quality criteria used to group items on the review form by one or more of the six data-evaluation criteria, and the terms that are commonly used to define the nature of the intended responses, respectively.

The NDAMS report review sheet (appendix 2) is divided into 12 sections and 14 water-quality constituent group subsections to facilitate the review process (tables 1 and 2). Each of the 12 sections of the review sheet provides standard information used to evaluate one aspect of the documentation provided for a given topic. Only the information found in a given report is recorded in the review. For example, if a report does not document flow measurements or constituent loads derived from precipitation or flow, then section 9 (Flow Monitoring Methods) would not be included in the review. If, however, a report does present constituent loads or indicates that flow was measured without any further documentation, then section 9 is included, but the section is annotated to indicate the lack of information necessary to support the flow or load data presented in the subject report.

All reports being reviewed are classified as being either review/summary documents, or detailed documents. Review/summary reports are brief overviews (of a large project) or a review of the literature and are not expected to contain the specific information or metadata necessary to characterize methods, sites, temporal information, or other details. Sections 1, 2, 7.0, and 8 are the only sections documented for summaries or literature reviews (table 1) because more detailed data-quality information is not generally available in these types of reports. Detailed documents--reports that describe the results of investigations, modeling studies, methods papers, or other reports containing data relevant to highway-runoff studies, are held to a higher standard for documentation and metadata review. Sections 1, 2, 3, 4, 5, 6, 7.0, and 8 are required for detailed reports. Sections 7.01 through 7.14 and sections 9 through 12 are used when data or information from these sections are available in a detailed document or when information from a section is needed to document report results. Information cannot be entered, however, if the report contains insufficient documentation. In this case, the lack of relevant information should be noted because the lack of adequate documentation is an important characteristic when considering a data set for future use.

Information in section 2 (Investigation and Report Information) indicates whether there is documentation in sections of the review sheet for each detailed report evaluated. If flow monitoring is documented for a given report, as indicated by an affirmative answer in section 2, the reviewer should complete section 9. If QA/QC information is documented, as indicated by an affirmative answer in section 2, the reviewer should complete section 10 and (or) section 11. Likewise, the reviewer should complete section 12 only if the report contains an uncertainty/error analysis as indicated by an affirmative answer in section 2.

Table 1. Organization of the National Data and Methodology Synthesis (NDAMS) Review Sheet.

[R--information required for all reports, D--required for all detailed reports, A--required if applicable to a given report]

Section Number	Requirement Status	Title	Purpose
1	R	Review Information	To identify the report being reviewed, the reviewer, and other administrative information.
2	R	Investigation and Report Information	To provide a short general overview of information documented within a given report.
3	D	Temporal Information	To provide information about the dates, duration, seasonality, and intensity of data collection efforts.
4	D	Location Information	To document identifiable sites and to record the availability of site-specific explanatory information.
5	D	Water-Quality Monitoring Methods	To document the availability of information on field methods pertinent to interpretation of data quality and comparability.
6	D	Sample Handling Methods	To document the availability of information on field and laboratory sample handling methods pertinent to interpretation of data quality and comparability.
7.0	R	Constituent Class	To document the availability of information on different classes of water-quality indicators.
7.01-7.14	A	Constituent Information	To document the availability of information on individual water-quality indicators grouped by constituent class.
8	R	Sampling Focus and Matrix	To document the physical focus, the hydrologic focus, and the matrixes sampled in each investigation.
9	A	Flow Monitoring Methods	To document data-quality information that may be used to evaluate measured flows and estimated loads of highway-runoff constituents.
10	A	Field Quality Assurance and Quality Control	To document use of field quality assurance and quality control elements currently deemed necessary to establish the veracity and the quality of data.
11	A	Laboratory Quality Assurance and Quality Control	To document use of laboratory quality assurance and quality control elements currently deemed necessary to establish the veracity and the quality of data.
12	A	Uncertainty/Error Analysis	To document the process of uncertainty/error analysis that will provide a quantitative assessment of the uncertainty inherent in environmental investigations.

Table 2. Organization of the National Highway Runoff Water Quality Data and Methodology Synthesis (NDAMS) Review Sheet water-quality constituent subsections

Section Number	Title	Operational Definition
7.01	Properties	Properties are defined herein as the physicochemical measures that indicate water quality and other parameters, such as weather, that are recorded on water-quality sampling field-record sheets as explanatory variables.
7.02	Deicers	Deicers are defined herein as the major inorganic constituents of road-salts, other deicers, and cyanide (which is used as a component of anticaking compounds in road-salts).
7.03	Majors	Major constituents are defined herein as the class of inorganic constituents commonly present in natural waters at concentrations exceeding 1.0 milligrams per liter.
7.04	Nutrients	Nutrients are defined herein as nitrogen and phosphorus species commonly measured as constituents in water-quality studies.
7.05	Metals and Trace Elements	Metals and trace elements are defined herein as the class of inorganic constituents commonly present in natural waters at concentrations less than about 1.0 milligrams per liter.
7.06	Solids, Sediment, and Turbidity	Solids, sediment, and turbidity are defined herein as measures of the amount of solids in a hydrologic system that may be incorporated into stormwater runoff.
7.07	Oxygen Demand	Oxygen demand is defined herein as measures of potentially biodegradable organic compounds in solution.
7.08	Organics	Organics are defined herein as carbon-based compounds that are identified as industrial/urban pollutants in stormwater investigations.
7.09	Pesticides and Herbicides	Organics are defined herein as carbon-based compounds used for control of undesirable species in agriculture, landscaping, and right-of-way maintenance.
7.10	Microbiology	Microbiology is defined herein as measures of water quality in terms of the number of microorganisms of species commonly used to indicate impaired water quality.
7.11	Eutrophication	Eutrophication is defined herein as measures of the trophic state of a water body receiving runoff.
7.12	Biological Parameters	Biological parameters are defined herein as measures of the effect of water- quality constituents on organisms present in the ecosystem at documented monitoring sites.
7.13	Toxicity Testing	Toxicity testing is defined herein as direct measures of the effect of water- quality constituents on test organisms.
7.14	Other Constituents	Other constituents are defined herein as measures of water quality that do not fit into one of the previous categories and(or) were not measured in more than one of the highway- and urban-runoff reports reviewed for this national synthesis.

Each section of the NDAMS review sheet has a specific, intended purpose within the data assessment process (table 1). The purpose and scope of each section in the report-review sheets are described in brief to provide an overview of the review process. The detailed information necessary to evaluate the review process or to utilize the NDAMS review process is obtained by reading the detailed review instructions (appendix 3) in conjunction with the applicable pages from the review sheets (appendix 2).

Section 1: Review Information

The Review Information section of the NDAMS review form is for administrative purposes only. This section identifies the report being reviewed using basic citation data. Information in this section relates the report review and the subject of the report to the appropriate citation in the data base and is used to document other administrative information, such as the identity of the person doing the report review.

Section 2: Investigation and Report Information

The Investigation and Report Information section of the NDAMS review form provides general information about the purpose and scope of the report being reviewed. It provides basic information about each report reviewed in terms of the suitability of the report to meet highway-runoff research-information needs. This section includes information regarding the purpose of the report, the type of work presented in the type of report, and the general geographical area represented by the report. The organizations that conducted and sponsored the research are identified to facilitate further research when reports are deemed useful, indicate objectivity of the parties involved, and indicate the quality of information provided. Section 2 also provides an overview of some essential data-quality characteristics, such as an indication of the accessibility and format of documented data, the availability of QA/QC information, and the availability of an uncertainty analysis. This section indicates if information for different types of runoff data (concentrations, storm loads, and (or) annual loads) and, in general, the methods of obtaining the data (measured, calculated, or estimated) are documented in the report being reviewed. As an overview, this section also indicates whether more detailed information is available in the review. For example, if this section indicates that the report contained QA/QC information, then more details should be documented in section 10 (field QA/QC) and (or) section 11 (laboratory QA/QC).

Section 3: Temporal Information

The Temporal Information section provides details about the time frame, duration, and seasonality of data-collection efforts documented in a given report. Documentation of this temporal information is necessary to assess comparability of different data sets and overall data quality. Knowing the year(s) in which the field work took place provides information about prevalent study methods, and hydrologic variables, such as wet periods or droughts, and background conditions, such as use of leaded fuels, that may affect data collected during a given study period. Defining the duration of the study and the number of storms sampled indicates whether a data set would be expected to fully characterize the quality and quantity of runoff produced at a given site with respect to seasonality and long-term variations in weather and precipitation. Analysis of a data base of highway-runoff data from the Minnesota State DOT from several sites over a 7-year period indicates that it is necessary to sample a minimum of 15 to 20 storms over several years to obtain a representative population providing reasonable estimates of the event-mean concentrations of runoff events (Thomson and others, 1997).

Information about the study dates is essential for putting the data collected in perspective in relation to methods used, changing trends in water-quality conditions, and for distinguishing between natural and anthropogenic factors that may be associated with a certain time period. Potentially relevant highway- and urban-runoff-quality data has been collected since the mid-1960's. Continual changes in science, technology, and society during this period give rise to variations in the constituents of highway-runoff water quality and the methods used to detect and measure these changes. Two examples of changes in pollutant sources are the banning of leaded gasoline and the cessation of asbestos use in automobile brake pads (Young and others, 1996). Knowledge of the time period in which the sampling program was completed also indirectly indicates other data-quality information, such as prevalent laboratory and field methods, detection limits, and the potential availability of detailed paper and electronic records documenting research methods and results for each data set.

The duration of the study helps to characterize the data quality. For example, a study may provide a detailed interpretation of water-quality values for one storm, but will not characterize differences from storm to storm, season to season, or year to year without a sufficient amount of data to characterize events at each respective time scale. Experience indicates that for water-quality investigations, a field study period of 2-3 years is necessary to account for variability in weather and total precipitation (Averett and Schroder, 1994). Data from projects of shorter duration may be sufficient for the study for which they were designed, but not for the scope of a national synthesis for highway-runoff quality. To be considered complete, a data set should characterize seasonality over more than one year because loads can vary considerably from year to year. For example, annual highway-runoff solute loads have been shown to vary annually from approximately 50 to 200 percent of the median over a 5-year period (Granato, 1996).

Documenting the number, date, and type of events occurring during individual sampling rounds provides information for evaluating how well a data set characterizes variability caused by differences among storms and by seasonality. For example, dissolved constituent loads are expected to be elevated in the winter in areas where deicers are used. Additionally, snowmelt events have different hydrologic and water-quality characteristics than rainfall-runoff events (Driscoll and others, 1990a,b; Harrop, 1983). Documenting the dates and times sampled indicates the completeness of the sampling program. These data can then be compared to precipitation data from national weather records, which may be used to determine the antecedent dry period for each storm in the study area.

Section 4: Location Information

The Location Information section provides specific details about individual study sites. Many of the explanatory variables that can be used to characterize highway runoff and its potential effects on receiving water and biota vary with location (Driscoll and others, 1990a). Documented location information is necessary to assess the potential repeatability and comparability of a study. In a review of existing water-quality data collected by Federal, State, and local water-quality-monitoring entities, Hren and others (1987), determined that detailed documentation of location information was necessary to interpret differences among sites and to allow repeatable sampling efforts when data were suspect or information on changes in water quality with time were required. The precise location of a data-collection station is necessary to ensure the ability to repeat sampling at that station. Information about site characteristics is necessary to assess comparability for intersite comparisons. The ITFM has established a minimum set of criteria to be documented with sampling and analytical data (Intergovernmental Task Force on Monitoring Water Quality, 1995a, b). One such criterion is documentation of the latitude and longitude of the study site. Location coordinates are an explanatory characteristic for interpreting results in terms of geography and climate, and the degree of accuracy associated with location coordinates are a precise repeatability characteristic.

Site-specific explanatory data have proven especially useful in past evaluations of highway runoff quality. Gupta and others (1981) established that the concentrations and loads of constituents in highway-runoff were affected by site characteristics including:

- highway design features,
- traffic characteristics,
- climatic conditions,
- maintenance policies,
- surrounding land use,
- percentage impervious area,
- type of pavement material,
- average age of automobiles in the study area,
- application of littering and vehicle emission laws,
- use of additives in vehicular operation,
- types of soils and vegetation along the highway, and
- local and regional atmospheric deposition.

Many of the same site features have also been used as explanatory variables in subsequent investigations of the characteristics of highway runoff (Driscoll and others, 1990a; Irish and others, 1996; Thomson and others, 1996; Young and others, 1996). As explanatory variables, many of these site features also indicate the comparability of data collected at each site. For example, the effect of pollutants introduced from surrounding sources associated with a particular land use could confound quantitative interpretation of the effect of an explanatory variable, such as average daily traffic (ADT), if not identified.

Section 5: Water-Quality-Monitoring Methods

The Water-Quality-Monitoring Methods section is designed to record details about the documentation of the monitoring program reported for each study. Documented water-quality-monitoring methods are necessary to assess the comparability of the data and overall data quality, as well as to identify explanatory characteristics. Methods and materials for monitoring water quality can substantially affect measurement results (Norris and others, 1990; Horowitz, 1991). Data sets may not be comparable unless it has been demonstrated that the different methods used to collect data from the different studies produce equivalent results. Documentation of validated methods indicates that available data are of a known quality, and that the research team was aware of the factors important to the data-collection process. When methods are validated, the data collected can be explained and related to other data sets in a quantitative manner.

The comparability, quality, and interpretation of water quality depend heavily on the design and implementation of the monitoring program. The design of sample-collection efforts in relation to the storm hydrograph and base flow (or lack thereof) will indicate how well a data set may characterize the system under study. Research has shown that continuous monitoring of flow and water-quality properties is critical for understanding rainfall/runoff/wash-off processes and that these records are necessary for obtaining quantitative pollutant loads (Fisher and Katz, 1984; Spangberg and Niemczynowicz, 1992; Church and others, 1996; Granato and Smith, 1999). The type of sampling effort (discrete or composite) is also an important factor in establishing data quality and comparability. Detailed, discrete data can be used to estimate runoff processes within storm events and can be used to estimate storm loads and event-mean concentrations (EMCs). The high cost of sample analysis, however, often precludes discrete sampling for many studies, so a single EMC is determined from a composite sample. The EMC measured may be affected by the sample collection and compositing protocol.

Section 6: Sample-Handling Methods

The Sample-Handling Methods section is designed to record details about the documentation of sample collection, processing, shipping, and analysis in terms of common sample-handling protocols (for example, the sample handling protocols specified in the storm water sampling guidance document; U.S. Environmental Protection Agency, 1992). Documented sampling-handling methods are important to assess data quality and to meet established legal requirements. Sample integrity depends upon proper and timely sample-handling methods. For example, measured concentrations of trace metals can be attenuated or magnified by up to 300 percent if proper methods are not used in each step of the sample-handling and processing procedure (Benoit and others, 1997).

Differences in handling methods can often overshadow the real deviations caused by variations in the explanatory variables (Intergovernmental Task Force on Monitoring Water Quality, 1995a). Upon collection, a sample starts to undergo biological, chemical, and physical changes almost instantly (Brown and others, 1970; U.S. Environmental Protection Agency, 1992; Horowitz and others, 1994). The quality of the data depends on controlling, minimizing, measuring, and documenting these changes. This can be done in a variety of ways, including the addition of preservatives, selection and use of standard processing materials of known composition and purity, and controlling (and documenting) sample-holding times.

In order for data to be admissible in court, they must be able to withstand reasonable challenge to their quality and veracity. Legal requirements for sample handling may include chain-of-custody documentation and analysis by certified analytical laboratories (U.S. Environmental Protection Agency, 1992). Even these requirements, however, do not guarantee the precision and accuracy of data. Historically, inconsistent performance within and between analytical laboratories has been a constant and substantial source of uncertainty (U.S. General Accounting Office, 1981; Farrar, 1998). Thus, for a regional or national synthesis, data are only useful if collected and analyzed in a consistent manner that is well documented and accepted by the scientific and regulatory communities.

Section 7: Constituent Information

The Constituent Information section is designed to document measured properties, constituents, and other water-quality indicators that are described in each reviewed report. In section 7, similar types of constituents are organized in operational groups consistent with the focus of highway- and urban-runoff studies (fig. 1). The properties, constituents, and measures of water quality that are commonly analyzed in comprehensive water-quality investigations of urban and highway runoff are classified into 14 categories. These categories are defined according to the operational definitions that are prevalent among reports of nonpoint source contamination. The constituent categories are described in table 2.

The first page of section 7, identified as section 7.0, indicates which constituent categories are documented within the report being reviewed. Summary and review reports are documented only in section 7.0 because these reports do not include the detailed methods information necessary to evaluate the original data and they may combine data that are not truly comparable. For example, a population of constituent concentrations analyzed by one laboratory or measurement technique may not have the same population characteristics as a similar population analyzed by a different laboratory or with a different technique (Childress and others, 1987). For reports with detailed information, section 7.0 indicates the availability of data for specific constituents documented within a given report. Data sheets for the subsections of section 7 are designed to document data-quality information specific to the particular class of constituents where appropriate. Data-quality information is recorded at the beginnings of the appropriate subsections. Each subsection contains fields in which the reviewer can record whether individual constituents were documented as having been analyzed in a given report. Additionally, document information specific to each class of constituents, such as analyte matrixes and analytical detection limits for each constituent, is also included in the form where appropriate.

Constituents of interest to highway decision makers can be added to section 7. During each review, constituents that can be identified as belonging to a specific category are included within that category. In cases where new constituents were not clearly identified by category, they can be recorded in section 7.14 (Other Constituents). The constituents included in section 7 are available on common laboratory analysis schedules, are of potential interest to runoff studies, or are documented in more than one runoff report from different studies.

Section 8: Sampling Focus and Matrix

The Sampling Focus and Matrix section is designed to document detailed information about the physical focus, hydrologic focus, and the analytical matrix used to measure concentrations of water-quality properties and constituents documented in each report reviewed. Information about the documented sampling focus and matrix is important to assess data comparability. The physical focus indicates what type of site (or sites) was documented as being sampled in a given report. The physical focus includes site categories, such as highway, BMPs, and other natural and constructed waterways. The hydrologic focus includes the four major components of the hydrologic cycle (atmospheric deposition, surface water,

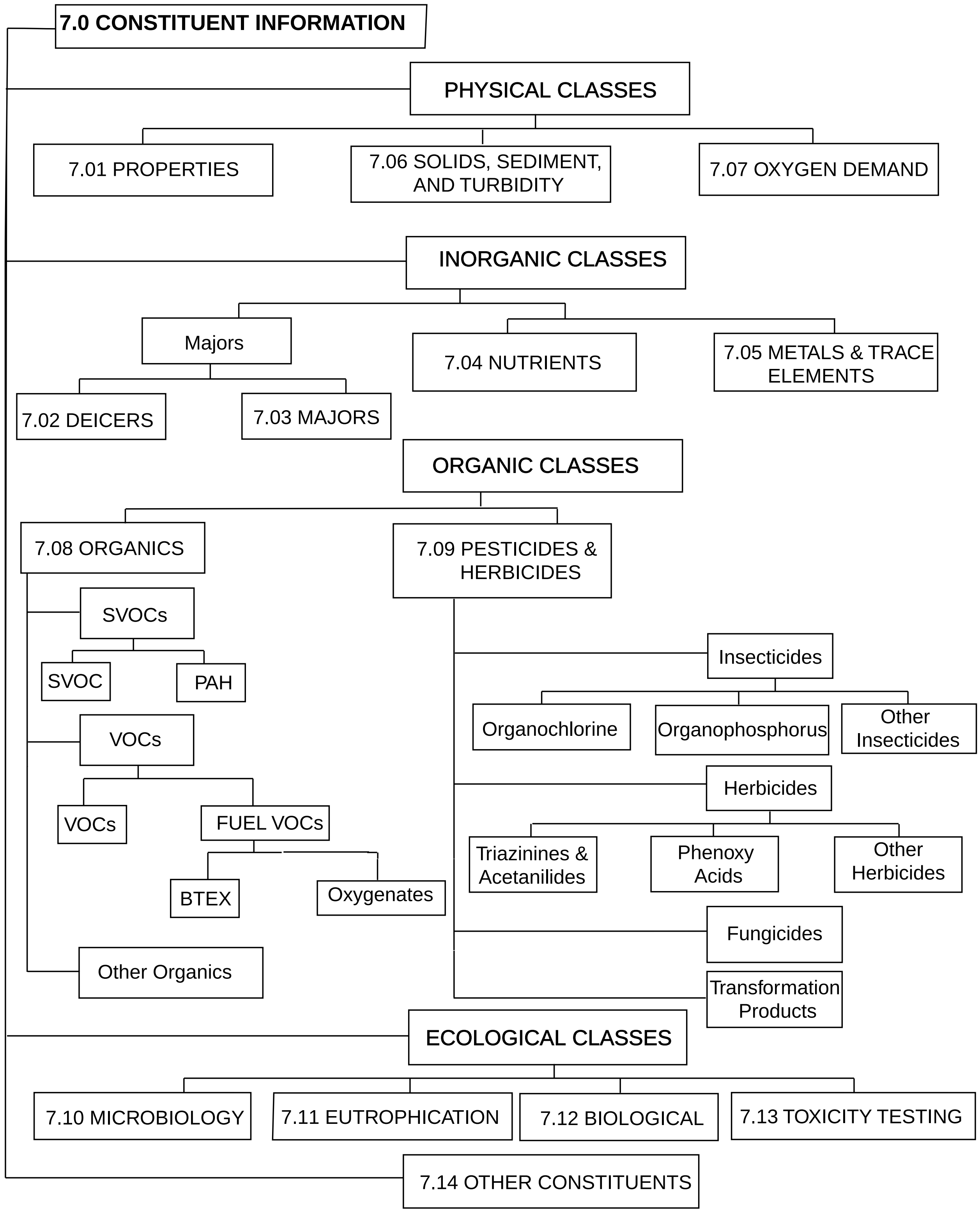

Figure 1. Classification of the water-quality constituent subsections among operational groups consistent with the focus of highway and urban runoff studies.

the unsaturated zone, and ground water). The matrixes include biota, water, sediment, air or gas, and “other matrixes.”

Data that is comparable is taken from the same matrix using documented sampling and analysis methods (Intergovernmental Task Force on Monitoring Water Quality, 1995a, b). Different water-quality data bases may provide hundreds or thousands of constituent concentration measurements, but only the samples extracted from the same physical focus, hydrologic focus, and matrix should be combined for interpretive efforts. As a general rule, direct comparisons cannot be made between analysis of samples taken from different matrixes. For example, combining data from studies designed to collect dissolved constituent concentrations (in filtered water) with data from studies designed to collect total concentration (water and suspended solids) may obscure meaningful interpretations because the concentrations of metals and other constituents in suspended solids can be orders of magnitude higher than those in dissolved fraction (Chapman and others, 1982; Horowitz, 1991).

Section 9: Flow-Monitoring Methods

The Flow-Monitoring Methods section is designed to record detailed information about flow-monitoring activities documented in a given report. This section is divided by hydrologic focus into categories for surface water, ground water, precipitation, and "other flow data.” These divisions are necessary because documentation of methods and required metadata characteristics vary according to the focus within the hydrologic cycle.

Documenting flow-monitoring methods is necessary to assess the data quality of some key water-quality properties and constituents and the potential applicability of flow data for use as an explanatory variable for highway-runoff assessments. Accurate and well-documented flow-measurement data are necessary to interpret measured concentrations and to calculate pollutant loads, event mean concentrations, and sediment-transport distributions. To properly composite a water sample for analysis of an EMC, or to mathematically determine an EMC from a series of discrete samples, accurate flow data are necessary (Driscoll and others, 1990a; U.S. Environmental Protection Agency, 1992). Therefore, the validity and defensibility of a study’s water-quality data often depend substantially on the documented integrity of the flow data.

Flow also serves as an explanatory characteristic. For example, higher rainfall intensities might result in higher peak constituent concentrations and loads because of increased rates of washoff. Sustained high flows can also cause a decrease in measured concentrations by dilution and (or) source depletion (Irish and others, 1996). Detailed information about flow-measurement data is necessary to establish flow data as an explanatory characteristic, to normalize results between studies, and to document the quality and comparability of data. Section 9 is used to record the metadata required for documenting precipitation and surface-water-flow-monitoring effects. Section 9 has this emphasis because most highway-runoff quality studies are focused upon the generation of flow and the transport of surface runoff from highways and proper documentation of methods and resulting metadata for measuring flow in the unsaturated zone and ground water are more complex and highly site specific. Much of the information necessary to evaluate studies in the unsaturated zone and ground water (such as the physical and chemical properties of soils and underlying aquifer materials, the depth to ground water, local precipitation. and evapotranspiration data) should be recorded with location information for these studies.

Sections 10 and 11: Field and Laboratory Quality Assurance and Quality Control

The Field and Laboratory Quality Assurance and Quality Control (QA/QC) sections were designed to document QA/QC efforts reported for a given study. QA/QC programs detect and control errors, as well as maintain and document the reliability and uncertainty of the data (Jones, 1999). Well-documented QA/QC programs are an essential part of all highway-runoff quality studies (Federal Highway Administration, 1986). Transportation agencies have successfully applied QA/QC principles to the acquisition of materials and construction contracts, and would do well to apply these principles to the process of data-quality acquisition (Jones, 1999). Documentation of QA/QC measurements is necessary to establish the quality and comparability of data, as well as the degree to which a data set may meet established legal requirements. Requirements for QA/QC programs have been increasing steadily during the last two decades and now address all aspects of data collection (Granato and others, 1998). The USEPA now requires QA/QC in every step of water-resources investigations to verify that data are valid, current, and technically defensible (U.S. Environmental Protection Agency, 1996; Jones, 1999). QA/QC documentation in the reviewed report should also address potential problems with program design, sample collection, sample transport, sample storage, chain of custody control, sample analysis, documentation, and data reporting (Intergovernmental Task Force on Monitoring Water Quality, 1995b).

When data from different studies are combined, differences in methods used to collect and analyze water-quality samples may obscure cause-and-effect relations (Childress and others, 1987). Therefore, available QA/QC documentation establishes the defensibility, comparability, and usefulness of a given data set for a given purpose.

Section 12: Uncertainty/Error Analysis

The Uncertainty/Error Analysis section is designed to record the degree to which investigators have documented random and systematic errors in measurements and resultant interpretation in the report being reviewed so that data-base users can evaluate a data set for their intended use (Holman and Gajda, 1984). The effect and relative importance of different sources of measurement error depend upon how they are weighted in the interpretive equations. Every measurement collected will have some degree of uncertainty associated with it. The total uncertainty associated with that measurement is the sum of uncertainty caused by natural variability, measurement errors, and interpretive generalizations. It is necessary to know the magnitude and sources of these uncertainties in order to evaluate the quality (accuracy, precision, and repeatability) and the comparability of data and resultant interpretations. Uncertainty arises from known or quantifiable sources, such as the expected tolerances of analytical measurement instruments. Uncertainty also arises from unknown or unquantifiable sources, such as a systematic bias in measurements from an instrument that may be caused by interference from a parameter that was not included in a sampling plan. Therefore, an analysis of the uncertainties in the results of a water-quality investigation depends upon a sound QA/QC program to quantify known sources and to detect unknown sources of uncertainty.

The acceptable uncertainty of data and interpretations for a given problem must be evaluated in terms of the regulatory objectives, the decisions to be made using the data, and the possible consequences of making incorrect decisions (U.S. Environmental Protection Agency, 1986; 1994). Uncertainty in the output of a predictive model will reflect the uncertainties from sampling programs because uncertainty in model results is, in part, caused by uncertainty within the input data, as well as the uncertainty incorporated by the modeling process (Young, 1983; Montgomery and Sanders, 1985; Haan and others, 1990). The modeling process can also introduce uncertainty through interpretive errors, data-entry errors, and model selection (Montgomery and Sanders, 1985).

Documented information required to evaluate a given data set using an uncertainty/error analysis may be either specifically or implicitly expressed. If the uncertainty is specifically expressed, the report reviewed will document a formal uncertainty/error analysis including identification of the individual uncertainties of each type of measurement and their effect on the interpreted results. For example, an explicit examination of the uncertainty of EMCs presented in a report would include statistics for the accuracy and precision of the components of the concentration and flow data, as well as the derivation of how the accuracy and precision of individual measurements are reflected in population statistics for EMCs determined in the study. If the uncertainty is implicitly expressed, the report reviewed will document the expected accuracy and precision of different types of measurements as the methods are described, or will document a general assessment of the total uncertainty without a complete or detailed analysis. In either case, results may be expressed in terms of significant digits, population statistics, percent error, or expected tolerances around the reported value.

QUALITY ASSURANCE AND QUALITY CONTROL IN THE REPORT-REVIEW PROCESS

Implementation and documentation of a quality-assurance and quality-control (QA/QC) program is necessary to support information and data that can be used to form valid management decisions (Federal Highway Administration, 1986; Clark and Whitfield, 1993; Jones, 1999). The NDAMS QA/QC program is part of the report-review process to help establish that the process will document the adequacy of a given data set to meet various highway-runoff information needs. The NDAMS program is designed to indicate the suitability of data for a number of highway-runoff information needs and various possible data-quality objectives (Granato and others, 1998). Therefore, the QA/QC program is necessary to establish that:

- the report-review process is adequate to meet the stated goals,
- valid protocols are used to collect and interpret metadata from each report, and
- these protocols are properly executed.

Each step in the report-review development and implementation process is addressed in the project QA/QC program, which is documented herein according to principles described by Jones (1999). The NDAMS report review QA/QC program is central to the review process and was implemented from the beginning of the NDAMS program.

The quality-assurance process is used to ensure that the reviews would provide the information needed to support decisions regarding the quality of highway runoff. Project goals and the design (as an assessment of published metadata) is established by a joint letter to the record between the FHWA and the USGS (Bank, F.G., FHWA, and Gray, J.R., written commun., 1996). Descriptions of the project design and goals of the report-review program are documented, reviewed, and approved by the FHWA and the USGS (Granato and others, 1998). The review protocols--implemented and documented herein as the standard NDAMS report-review sheets (appendix 2) and review instructions (appendix 3)--are the product of input from relevant literature and expert input from a number of professionals in the State DOTs, the FHWA, regulatory agencies, and the USGS (see Acknowledgments). Technical reviews of the review sheets and related documentation by the FHWA and the USGS during the design phase of the project and again during the technical report review of this document establish the adequacy of these products for the intended purposes.

Once the protocols are established and approved, the quality-assurance program provides a focus on the proper implementation of these protocols in a consistent manner throughout the study period. Quality-assurance practices include the use of:

- the standard review forms to record information (appendix 2);
- qualified staff, trained specifically to do report reviews for the project;
- standard data documentation algorithms to translate report documentation (or lack thereof) into metadata on report review forms (described in appendix 3); and
- development, use, and documentation of standard methods for quantitative measures, such as the use of PLACER (Granato, 1999) for interpolating latitudes and longitudes.

These quality-assurance measures were designed to create, to the fullest extent possible, a uniform method of interpretation and documentation.

The data-base design and implementation process is also part of the QA/QC efforts conducted by the USGS. The final data-base design reflects input from the experience of the report-review staff. Technical issues from the complete quality-assurance cycle--from planning through, data collection, data assessment, and potential uses for the information collected (Jones, 1999)--are incorporated in the transition from the review sheets on paper (appendix 2) to a functional data base. The data base is designed to further standardize the metadata recorded in report reviews, and the data entry and verification process embodies another method of verification of the contents of report reviews.

The project also incorporates a number of quality-control measures as part of the QA/QC program to ensure that the review protocols are properly executed. Quality-control measures include the use of:

- supervisory and group evaluations of completed reviews--to provide feedback on the data entry process;
- duplicate and replicate reviews of about 2 percent of randomly chosen report reviews to ensure that different reviewers were producing comparable results;
- independent comparison of report-review contents with a brief overview of the report being reviewed for about 10 percent of the report reviews to ensure that the information recorded is complete and correct;

- interactive feedback between reviewers during the review process to define choices and methods for interpreting information in published reports;
- independent data entry technicians trained to look for logical inconsistencies in the reviews as they are entered in the data base; and
- a detailed inspection of each review for completeness and internal consistency in conjunction with the report-review data-entry process in the data-base quality-control program.

Together, these quality-assurance and quality-control measures will ensure that the metadata documented by the report-review process will meet the stated objectives of this project. Components of the project serve to establish that the review-process protocols meet project objectives, and that the report reviews and subsequent data entry meet the requirements of the established review protocols. The entire QA/QC process for the project also includes QA/QC for the data entry of the review sheets, and the process of archiving the original review sheets with project records in the Federal Records Center.

SUMMARY

The highway-runoff research community recognizes that a readily accessible archive of information and data are necessary to make informed highway-planning, design, and management decisions based on data and information that are valid, current, and technically defensible. The NDAMS study was designed and implemented by the FHWA and the USGS with input from members of the Transportation Research Board (TRB) and professionals DOTs that are active in highway-runoff-quality research. The purpose of the NDAMS study is to catalog existing literature pertinent to the study of highway-runoff water quality and its effects on receiving waters and the environment, and to assess the suitability of the existing information to meet State, regional, and national water-quality information needs. A detailed review of the documentation of data in published reports pertinent to the study of highway runoff is necessary to record whether this documentation is sufficient to characterize pollutant characteristics, loadings, and effects from highway-runoff quality on a regional and (or) national scale. The review process is designed to determine if data and information documented in a report is sufficiently robust to withstand a technical challenge based upon current data-quality standards. The review process, however, was not designed for a predetermined set of data-quality evaluation criteria, but rather to provide the metadata necessary to evaluate the suitability of each report to meet information needs with respect to data-quality objectives defined by regulators or decision makers who are involved with a given highway-runoff-quality problem.

This report describes and documents the NDAMS review process. The body of the report explains the approach taken in implementing the NDAMS review process, provides a brief and general description of this review process, and describes the quality-assurance and quality-control measures used to manage the review process. A glossary (appendix 1) provides general definitions pertinent to the review process, specific terms as used in the review sheets, and terms used to categorize data elements. The standard forms used for the reviews are documented in appendix 2. Detailed instructions for each element in the review forms are documented in appendix 3. Therefore, the reviews are repeatable and the methods can be used by the FHWA, State

DOTs, and (or) other transportation research organizations to catalog new reports as they are published.

The NDAMS review sheet is divided into 12 sections and 14 water-quality constituent group subsections to facilitate the review process. The 12 sections are designed to document: (1) administrative review information, (2) investigation and report information, (3) temporal information, (4) location information (5) water-quality-monitoring information, (6) sample-handling methods, (7) constituent information, (8) sampling focus and matrix, (9) flow-monitoring methods, (10) field QA/QC, (11) laboratory QA/QC, and (12) uncertainty/error analysis. The 14 water-quality constituent subsections are divided among the properties, constituents, and measures of water quality commonly analyzed in comprehensive water-quality investigations of urban and highway runoff. The categories represented by the subsections are defined according to the operational definitions prevalent among reports of nonpoint-source contamination.

The review process is designed to evaluate a subsample of the cataloged information to determine if it is valid, current, and defensible from a technical and regulatory standpoint. A quality-assurance and quality-control program, implemented from the beginning of the program, is necessary to document that the project design is adequate to meet the stated goal, that valid protocols are used to collect and interpret data, and that these protocols are properly executed.

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Appendix 1

Appendix 1 – Glossary A—General Terms

The following are operational definitions for terms related to their uses in this report. Other definitions for these terms may apply in other instances.

Accuracy—The degree to which a measured value agrees with the true value of the measured property (Jones, 1999).

Atmospheric deposition—The transfer of substances from the air to the surface of the earth, either in wet or dry form. Some examples include rain, snow, fog, air, dust, and aerosols (Garabedian and others, 1998).

Attenuation—The reduction or removal of measurable forms of the constituent of interest by a physical or chemical reaction.

Automatic—To perform the tasks of a human operator by electronic, electromechanical or mechanical methods.

Bed material—The sediment mixture of which a streambed, lake, pond, reservoir, or estuary bottom is composed (Nevada Division of Water Planning, 1997).

Best management practice (BMP)— Procedural methods and(or) structural facilities designed to reduce effects of runoff flows and runoff contaminants on receiving waters. Some examples of procedural BMPs are street sweeping and the use of alternative deicing practices. Some examples of structural BMPs are grassy swales, detention ponds, and silt fences.

Biota—Flora or fauna occurring in the study area such as bacteria, algae, invertebrates, and other organisms (Hren and others, 1987).

Blank—A quality assurance sample that should not contain measurable quantities of the constituent of interest unless contamination is introduced in the sample collection, processing, shipping, or analysis process. Usually, a number of different blanks are used to isolate different potential sources of contaminants.

Calibration—Adjustment of the output reading of analytical measurement instrumentation to maximize the accuracy and precision of the readings and to eliminate systematic bias. Adjustments are made by using documented standard reference samples to validate and document the instrument readings.

Chemistry—The composition of a substance and the physical or chemical reactions that occur during transformations of a substance.

Colloids—Extremely small particles, typically 0.0001 to 1 micron in size, that remain suspended in a fluid medium without settling to the bottom. Colloids are objects of intermediate size between a dissolved particle and a suspended solid that will settle out of solution (Nevada Division of Water Planning, 1997).

Constituent—Any chemical substance found in water or other matrixes that are sampled, such as soil, sediment, or biota.

Contamination—A constituent inadvertently added to the sample during the sampling and (or) analytical process (Keith, 1996), or a constituent that is added to a receiving water from natural or anthropogenic sources that is perceived as a problem at measured concentrations in the receiving water.

Deicer (also salt-deicing chemical)**—**A substance, such as sodium chloride, calcium chloride, or calcium magnesium acetate (CMA), used to remove ice and snow from roadways in the winter.

Detection limit—A general term indicating the lowest value that a laboratory will report as the determination of the concentration of a constituent. More precise definitions of this term include the **Limit of Detection** or the **Limit of Quantitation**.

Dissolved—Solid particles that mix, molecule by molecule, with a liquid and appear to become part of the liquid (Nevada Division of Water Planning, 1997). The U.S. Environmental Protection Agency operationally defines "dissolved" as aqueous material able to pass through a 0.45-micron filter.

Effluent—Outflow from a particular source, such as the outfall of a particular highway runoff drainage system.

Environmental effects—The effects of stormwater runoff, other point or nonpoint source pollution, or habitat disturbance on the health, viability, or diversity of local plants and animals.

Eutrophication—The enrichment of a body of water by nutrients, either naturally or by pollution-rich dissolved nutrients, which commonly are phosphorus and nitrogen. Eutrophication often is indicated by a deficiency in dissolved oxygen (Nevada Division of Water Planning, 1997).

Filter residue—Sediment that remains on a filter after an aqueous analysis has been performed on a water sample.

Filtered water—Water that has been separated from suspended solids by a porous material through which the water passed.

Flow—(1) The rate of water movement past a specified point in a drainage area (Nevada Division of Water Planning, 1997) or (2) the movement of fluid.

Ground water—Water in the ground that is in the zone of saturation, from which wells, springs, and ground-water runoff are supplied (Langbein and others, 1960).

Herbicides—Chemical agents used to control plant growth.

Hydrograph—A graph that charts the water level and(or) discharge measured in a river, stream, swale, pipe, or other conveyance through time.

Limit of Detection (LOD)—The lowest concentration of an analyte that can be reliably distinguished from a blank by a given analytical method of measurement. Generally computed as three times the standard deviation of the blank (Jones, 1999).

Limit of Quantitation (LOQ)—The lowest concentration of an analyte that can be measured quantitatively by a given analytical method. Generally computed as 10 times the standard deviation of the blank (Jones, 1999).

Major constituents—Concentrations of elements that occur naturally in water at concentrations that are commonly greater than 1 milligram per liter (Hem, 1992).

Manual—The physical act of a person sampling a matrix or recording measurement instrument readings in compliance with a sampling or measurement protocol.

Metadata—Information that describes the content, quality, condition, and other characteristics of the data (Intergovernmental Task Force on Monitoring Water Quality, 1995a,b).

Metals/trace elements—Metals and similar elements that routinely occur in nature in concentrations less than 1 milligram per liter (Hren and others, 1987; Hem, 1992). Some examples include iron, lead, and zinc.

Method—A procedure or process for accomplishing something, such as collecting or analyzing a sample.

Matrix—The physical type of an environmental sample, such as water, soil, sediment, or biota (Keith, 1996).

Microbiology—The scientific discipline concerned with the study of organisms (microbes) that can be seen only with the aid of a microscope. Microbiology includes the study of the structure, chemical composition, and biochemical changes, including sources and effects of microbes on the environment (Nevada Division of Water Planning, 1997).

Monitoring—The repeated measurement of the same parameter(s) over time to assess the current status of the parameter(s) and changes in the parameter(s) with time.

Nutrient—A substance that is assimilated by organisms and promotes growth; generally applied to any or all of the constituents that contain nitrogen or phosphorus (Hren and others, 1987).

Organic—A compound that contains carbon. Some examples include organic and inorganic carbon, oil and grease, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and phenols (Hren and others, 1987).

Oxygen demand—The molecular oxygen (O_2) required for biological and chemical processes to occur in water. The amount of oxygen dissolved in water becomes a critical environmental constraint on the biota living in the water (Nevada Division of Water Planning, 1997).

Pesticide—A chemical agent (usually organic compounds) that is used to control the population of specific organisms. Some examples include insecticides, herbicides, and fungicides (Nevada Division of Water Planning, 1997).

Preservation—Procedures used to maintain the integrity of the sample; that is, to minimize changes in the sample from the time of sampling to completion of analysis (Parr and others, 1996).

Properties—Water-quality characteristics that are identified by measurements, such as water temperature, pH, and dissolved oxygen. These measurements generally are made at a data-collection site but may also be made in a laboratory (Hren and others, 1987).

Pure standard solution—A sample that is collected and processed by using standard methods and materials that have been documented and tested sufficiently to demonstrate that the sampling process does not introduce detectable concentrations of an analyte or any other contaminants that will bias measured concentrations.

Quality assurance—Planned and systematic activities implemented to provide adequate confidence that the activities are being completed so as to meet prescribed standards (Jones, 1999).

Quality audit—A systematic and independent examination to determine if planned and systematic activities, and related results, comply with planned procedures and whether these procedures were implemented effectively and are suitable to achieve planned objectives (Jones, 1999).

Quality control—Operational techniques and activities that are used to fulfill requirements for predetermined specifications for quality (Jones, 1999).

Reference material—A substance that has been extensively analyzed to determine a best value of the concentration of one or more of its constituents. Used to assess measuring systems, such as protocols, instruments, laboratories, or analytes.

Replicate samples—Two to more samples taken from the environment at the same time and place using the same sampling protocols. Used to estimate the random variability of the material sampled.

Representativeness—The extent to which a sample reflects the population from which it is withdrawn.

Sample—A portion of a physical system that is studied with the assumption that it represents the system of interest (Keith, 1996).

Sediment—Material that is suspended in water or recently deposited from suspension. It includes any or all of the following modes in which particulate matter exists in water: suspended sediment, bed material, bed load, and total sediment load (Hren and others, 1987; Nevada Division of Water Planning, 1997).

Sediment core—A vertical section of sediment collected as a sample for examination and(or) laboratory analysis.

Soil—The layer of unconsolidated organic and inorganic material that nearly everywhere forms the surface of the land and rests on bedrock (Nevada Division of Water Planning, 1997).

Specific conductance—The measure of the ability of water to conduct an electrical current by using a 1-centimeter cell and expressed in units of electrical conductance, such as microsiemens or micromhos, at a specified temperature, usually 25° Celsius. Specific conductance is determined by the type and concentration of ions in solution and can be used for approximating the total dissolved solids (TDS) content of water (Nevada Division of Water Planning, 1997).

Standard methods—A shortened form to mean Standard Methods for the Examination of Water and Wastewater, which is a series of protocols prepared and published every 5 years jointly by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation. The book is the primary reference for analytical methods that are employed in investigations and in the monitoring of water purification, sewage treatment and disposal, water pollution, sanitary quality, and other water-quality activities (Nevada Division of Water Planning, 1997).

Surface water—Water that is naturally exposed to the atmosphere and flows or is naturally or artificially dammed, and thereby ponded, on the surface of the earth. Examples of surface water include rivers, lakes, reservoirs, estuaries, and seas.

Suspended sediment (suspended solids)—Particles that remain in suspension in water for a considerable period of time without contact with the bottom of the water body. These solids are not in true solution and can be removed by filtration (Nevada Division of Water Planning, 1997).

Total maximum daily load (TMDL)— The maximum quantity of a particular contaminant that can be discharged into a body of water without violating water-quality standards. The amount of contaminant is determined by the U.S. Environmental Protection Agency (USEPA) when existing, technology-based effluent standards for water contamination sources in the area do not meet one or more ambient water quality standards (Intergovernmental Task Force on Monitoring Water Quality, 1995a,b).

Toxicity testing—A procedure that is used to determine the toxicity of a chemical or an effluent on a particular species of living organism. Toxicity tests measure the acute or chronic adverse health effect of a specific chemical or effluent on exposed test organisms (Nevada Division of Water Planning, 1997; Intergovernmental Task Force on Monitoring Water Quality, 1995a,b).

Turbidity—The degree to which suspended matter and (or) the color of water interferes with the passage of light through the water (Nevada Division of Water Planning, 1997).

Uncertainty–A measure of the errors in, and losses of, information inherent in environmental studies that prevent the characterization of exact properties of the underlying distribution of the measured population (Ward and Loftis, 1983; Holman and Gajda, 1984).

Urban—Relating to the physical, hydrological, atmospheric, and (or) land-use identification of an area as being in or near a city.

Watershed—The area within which all surface water flows to a readily definable water course or water body.

Whole water—A water sample that is processed and analyzed to include constituents associated with suspended sediments and dissolved constituents.

Appendix 1 - Glossary B—Terms used in review sheet

Calculated—Determined by a mathematical operation. A parameter, such as flow, concentration, or load, can be indirectly calculated from related measurements.

Composite—A sample that purportedly represents the average value of water quality constituents in time and (or) space.

Discrete—A sample that is distinct in time and (or) space in which it was collected.

Estimated—A calculation based on interpretation of measured and observed variables, usually involving extrapolation of calculations beyond or between measured results. For example, a parameter, such as flow, concentration, or load, that can be estimated from limited data by using rational formulas, regression equations, or charts.

Graphic—The presentation of data in graphs, charts, and (or) types of figures.

Measured—The determination of a value by a direct method of quantitation. A parameter, such as flow or concentration, is measured if the value was derived from observation of a quantifiable variable.

Not applicable (NA)—A choice that indicates that a particular subject does not apply in a particular instance or situation.

No (N)—A choice that indicates that a particular subject was not documented or was documented as a negative response; for example, the method was not performed, or the constituent was not measured in the study discussed or mentioned in the report.

Table—The presentation of data in tabular form.

Unknown (U)—A choice that indicates that a particular subject was documented in an inconclusive manner; for example, there is relative uncertainty that a particular method was used or that a particular constituent was tested for in the study. In some cases that are noted in Appendix 3, this applies if (1) the parameter is mentioned but no specific details are given or (2) another report is referenced for the information in question.

Yes (Y)—A choice that indicates that a particular subject was documented or was documented as an affirmative; for example, the method was performed or the constituent was tested for in the study

Appendix 1 – Glossary C—Data-evaluation criteria characteristics

Accessibility characteristic—The degree to which data are available for future use. This includes detailed documentation of original data, preferably in an easily transferable electronic format.

Comparability characteristic—The potential for one-to-one comparisons to be made between data within and among data sets. This characteristic must demonstrate that equipment, methods, and procedures that are used to collect and analyze data produce results that consistently represent environmental conditions among methods so that the differences within and among data sets accurately represent differences in explanatory variables.

Data-quality characteristic—The degree to which experimental uncertainty in a data set was documented as being controlled to achieve an acceptable level of confidence in decisions that are based on the data.

Explanatory characteristic— Information that can be used in standardizing data to a common basis for comparison, or to account for some of the variability in the data (Norris and others, 1990).

Legal requirement—A characteristic that demonstrates that the sampling program was designed to produce legally admissible data (Klodowski, 1996). For example, proper data-collection methods must be documented, and data verification and interpretation by qualified personnel must be demonstrated.

Repeatability characteristic—The degree to which the documentation affords the ability for a particular part of the study to be reproduced to check the original measurements or to detect changes with time (for example, whether the specific study site can be located precisely for further sampling by a third party).

Appendix 2

APPENDIX 2 - NATIONAL DATA AND METHODOLOGY SYNTHESIS (NDAMS) DATA REVIEW SHEET

1. REVIEW INFORMATION

2. INVESTIGATION AND REPORT INFORMATION

3. TEMPORAL INFORMATION

4. LOCATION INFORMATION

5. WATER-QUALITY-MONITORING METHODS

6. SAMPLE-HANDLING METHODS

7. CONSTITUENT INFORMATION
    - 7.01 PROPERTIES
    - 7.02 DEICERS
    - 7.03 MAJOR CONSTITUENTS
    - 7.04 NUTRIENTS
    - 7.05 METALS AND TRACE ELEMENTS
    - 7.06 SOLIDS, SEDIMENT, AND TURBIDITY
    - 7.07 OXYGEN DEMAND
    - 7.08 ORGANICS
    - 7.09 PESTICIDES AND HERBICIDES
    - 7.10 MICROBIOLOGY
    - 7.11 EUTROPHICATION
    - 7.12 BIOLOGICAL PARAMETERS
    - 7.13 TOXICITY TESTING
    - 7.14 OTHER CONSTITUENTS

8. SAMPLING FOCUS AND MATRIX

9. FLOW-MONITORING METHODS

10. QA/QC FIELD

11. QA/QC LABORATORY

12. UNCERTAINTY ANALYSIS/ERROR ANALYSIS

NATIONAL DATA AND METHODOLOGY SYNTHESIS (NDAMS) DATA REVIEW SHEET

1. REVIEW INFORMATION

Reviewer: ____________________________ **Hours:** ____ **Pages:** _________

Year: __________ **Code:** ______________ **Change code:** Y N

Why: ____ **New code:** ___________

Report First author: _______________________ **Report number:** ______

Title: ____

____

2. INVESTIGATION AND REPORT INFORMATION

First author affiliation: ____

Report sponsorship: ____

Purpose: ____

____

____

Peer review: Y N U comment: ___________________________________

Type of report: review/summary data data/interpretive methods modeling regulatory/management monitoring/permit guide other: ____

Study location(s) (country/state/highway): _________________________

Area of study: point(s) local watershed regional national international other: ____

Number of study sites: ____

QA/QC program: Y N U comment: __________________________________

Original data availability: Y N U comment: ______________________

Data presentation: individual summary NA other: _________________

Data form: graphic table NA other: _______________________________

Electronic availability: Y N U format: __________________________

Uncertainty analysis: Y N U **Indication of uncertainty:** Y N U

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

2. INVESTIGATION AND REPORT INFORMATION (cont.)

Reported:

Flow: Y N measured calculated estimated _______________

Concentrations: Y N measured calculated estimated _______________

Storm loads: Y N calculated estimated ___________________________

Annual Loads: Y N calculated estimated __________________________

Remarks: ____

____

Abstract: Path and filename of ASCII text: _______________________

____

Recommended further study: _______________________________________

____

____

____

____

____

____

____

____

Problems mentioned in study (by author): __________________________

____

____

____

____

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials _______** **Report _____**

3. TEMPORAL INFORMATION

Date(s) of field work (period of record)

Begin: _ _ _ _ _ _ **End:** _ _ _ _ _ _
M M Y Y Y Y M M Y Y Y Y

Remarks: ____

Months: J F M A M J J A S O N D ??

Number of sampling rounds: __________________

Total number of storms: ______ rain:______ snow:______ melt:______

Antecedent dry period(s): Y N U by-storm average range ??

Comments: ____

____

____

____

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

4. LOCATION INFORMATION (page 1 of 3) Site number _______ of ______

Site name descriptor: ____

Location: Country: ______________________ **State:** __________________

Postal abbreviation: __ __ **Province:** _______________

City/town/county/other: ____

____

Watershed: ____

Highway, State or Interstate route: _______________________________

____

Latitude and Longitude:

LAT _ _ _ _ _ _ **Accuracy:** ___Deg ____Min _________Sec
D D M M S S

LON _ _ _ _ _ _ _ **Accuracy:** ___Deg ____Min _________Sec
D D D M M S S

Drainage area (mi^2): ______ **Percent of watershed:** ______

Site land use: highway transportation industrial commercial

urban-mixed suburban-mixed agricultural rangeland forest

wetland water other:____

Surrounding land use: highway transportation industrial commercial

Urban-mixed suburban-mixed agricultural rangeland forest

wetland water other:____

Percent impervious: ______ **Percent pavement:** ______

Highway characteristics: Lanes: ___ **Length of road surface:** _______

Pavement type: ____________________________________ Curbing: Y N U

Section: level cut fill cut-and-fill bridge BMP

other:____

no information for page: (2 of 3) (3 of 3)

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

4. LOCATION INFORMATION (page 2 of 3) Site number _____ of _______

Traffic: Posted speed limit: ________ Average vehicle age: _______

Average daily traffic: _________ Method: __________________________

ADT duration: ____________________ Uncertainty: ___________________

Vehicles during storm: ___________ Uncertainty: ___________________

Acceleration or braking areas (ramps): ____________________________

Drainage system type: swale pipe combined sewer other:

____

____

Maintenance and Right-of-way practices:
(deicing, sweeping, pesticide/fertilizer/catchbasin cleaning, etc.)

____

____

____

BMP used: pond swale wetland none other:

____

____

____

____

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

4. LOCATION INFORMATION (page 3 of 3) Site number _____ of _______

Geographic characteristics (local): ______________________________

____

____

Local area soil attributes (type, CEC/CER, etc.): _________________

____

____

Local vegetation (type, condition): ______________________________

____

____

Precipitation:

Volume total and snow: ____

Number of storms/year: ____

Intensity: ____

Duration: ____

Mean monthly event: ____

Mean monthly antecedent dry period: ______________________________

Mean annual temperature: ____

Mean January temperature: ____

Average wind speed: ____

Other useful information: ____

____

____

NDAMS DATA REVIEW SHEET Reviewer's Initials _______ Report _____

5. WATER-QUALITY-MONITORING METHODS

Sampling program: periodic random storm event other: __________

____

Change in stage: rising falling steady peak base-flow

storm-hydrograph U other: ______________________________________

Continuous monitoring of water level: Y N U ______________________

Continuous monitoring of QW properties: Y N U ___________________

QW properties monitored continuously: SPC water temp air temp pH

DO redox(or pe) turbidity other:________________________________

Sampling: manual automatic both comment: _______________________

In time: discrete composite comment: ___________________________

In space: discrete composite comment: __________________________

Compositing method: manual automatic U __________________________

Compositing protocol: ____

____

First flush samples: Y N interval/comment __________________________

Sampling materials: ____

____

____

____

____

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

6. SAMPLE-HANDLING METHODS

Chain-of-custody: Y N U comment: ______________________________

Samples homogenized: Y N U

Methods: ____

____

Preservation: Y N U

Methods: ____

Materials: ____

Field shelf life before analysis: Y N U _________________________

____

Lab shelf life before analysis: Y N U ___________________________

____

Field processing materials: ____

____

Lab processing materials: ____

____

Name of laboratory used: ____

____

Certified : ____

Standard field forms: Y N U comment: ___________________________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

WHAT ANALYTES WERE MEASURED:

7.01 PROPERTIES (SPC   Temp   pH   DO redox other): Y N

7.02 DEICERS (Ca Na Cl SO4 CMA other): Y N

7.03 MAJOR CONSTITUENTS: Y N

7.04 NUTRIENTS: Y N

7.05 METALS AND TRACE ELEMENTS: Y N

7.06 SOLIDS, SEDIMENT, AND TURBIDITY: Y N

7.07 OXYGEN DEMAND: Y N

7.08 ORGANICS: Y N

7.09 PESTICIDES AND HERBICIDES: Y N

7.10 MICROBIOLOGY: Y N

7.11 EUTROPHICATION: Y N

7.12 BIOLOGICAL PARAMETERS: Y N

7.13 TOXICITY TESTING: Y N

7.14 OTHER CONSTITUENTS: Y N

NDAMS DATA REVIEW SHEET **Reviewer's Initials _______** **Report _____**

7. CONSTITUENT INFORMATION
7.01 PROPERTIES

Calibration: Y N U comment: ____________________________________

Temperature compensation: Y N U comment: ________________________

Periodic maintenance: Y N U comment: __________________________

Specific conductance: Y N units: _______________________________

pH: Y N units: ____

Method: ____

Oxidation reduction potential: Y N units:______________________

Method: ____

Temperature air: Y N units: ___________________________________

Temperature water: Y N units: _________________________________

Color: Y N units: _______ Method: _____________________________

Odor: Y N units: ________ Method: _____________________________

Dissolved oxygen DO: Y N units: ________________________________

Method: ____

Hardness as CaCO3: Y N units: _________________________________

Method: ____

Acidity: Y N units: ____

Method: ____

Alkalinity as CaCO3: Y N units: ________________________________

Method: ____

Barometric pressure: Y N units: ________________________________

Method: ____

Weather: ____

Debris/garbage: ____

NDAMS DATA REVIEW SHEET **Reviewer's Initials _______ Report _____**

7. CONSTITUENT INFORMATION

7.02 DEICERS (page 1 of 1)

Calcium Ca: Y N Reported: total dissolved U other _____________

Sodium Na: Y N Reported: total dissolved U other _____________

Chloride Cl: Y N Reported: total dissolved U other _____________

Sulfate SO4: Y N Reported: total dissolved U other _____________

Cyanide CN: Y N Reported: total dissolved U other ______________

Calcium magnesium acetate CMA: Y N

Reported: total dissolved U other ______________________________

Other deicer: Y N ____

Reported: total dissolved U other ________________________________

7.03 MAJOR CONSTITUENTS (page 1 of 1)

Bicarbonate HCO3 (Bicarbonate Alkalinity as CaCO3):

Y N Reported: total dissolved U other ___________________________

Boron B: Y N Reported: total dissolved U other _________________

Carbonate CO3 (Carbonate Alkalinity as CaCO3):

Y N Reported: total dissolved U other ___________________________

Carbon Dioxide CO2: Y N Reported: total dissolved U other _____

Clorine Cl: Y N Reported: total dissolved U other _____________

Floride F: Y N Reported: total dissolved U other _______________

Hydroxide OH: Y N Reported: total dissolved U other ___________

Manganese Mn: Y N Reported: total dissolved U other ____________

Magnesium Mg: Y N Reported: total dissolved U other ____________

Potassium K: Y N Reported: total dissolved U other _____________

Silica SiO2: Y N Reported: total dissolved U other _____________

Sulfide H2S: Y N Reported: total dissolved U other _____________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.04 NUTRIENTS (page 1 of 1)

Nitrogen as N: Y N ____

Reported: total dissolved U other ________________________________

Nitrate: Y N ____

Reported: total dissolved U other ________________________________

Nitrite: Y N ____

Reported: total dissolved U other ________________________________

Nitrite plus nitrate: Y N ______________________________________

Reported: total dissolved U other ________________________________

Nitrogen ammonia: Y N ____

Reported: total dissolved U other ________________________________

Nitrogen, organic: Y N ____

Reported: total dissolved U other ________________________________

Nitrogen, kjeldahl: Y N _______________________________________

Reported: total dissolved U other ________________________________

Phosphorus as P: Y N ____

Reported: total dissolved U other ________________________________

Phosphorus as PO4: Y N ____

Reported: total dissolved U other ________________________________

Phosphorus orthophosphate: Y N ________________________________

Reported: total dissolved U other ________________________________

Phosphorus organic: Y N _______________________________________

Reported: total dissolved U other ________________________________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.05 METALS AND TRACE ELEMENTS (page 1 of 3)

Clean trace-element sampling protocols used: Y N U

Describe: ____

Matrix: suspended sediment: Y N whole water: Y N

filtered water: Y N sediment core: Y N   other: ________________

Filter: filter type: ______________ pore size:____________________

material: __________________________ size: ________________________

Sampler material: ____

Processing material: ____

Preservation: ____

Aluminum Al: Y N Reported: total dissolved U other_______________
Detection limit(s):   <________   <________   <________

Antimony Sb: Y N Reported: total dissolved U other_____________
Detection limit(s):   <________   <________   <________

Arsenic As: Y N Reported: total dissolved U other________________
Detection limit(s):   <________   <________   <________

Barium Ba: Y N Reported: total dissolved U other_________________
Detection limit(s):   <________   <________   <________

Beryllium Be: Y N Reported: total dissolved U other______________
Detection limit(s):   <________   <________   <________

Bismuth Bi: Y N Reported: total dissolved U other________________
Detection limit(s):   <________   <________   <________

Bromide Br: Y N Reported: total dissolved U other________________
Detection limit(s):   <________   <________   <________

Cadmium Cd: Y N Reported: total dissolved U other________________
Detection limit(s):   <________   <________   <________

Cerium Ce: Y N Reported: total dissolved U other________________
Detection limit(s):   <________   <________   <________

Cesium Cs: Y N Reported: total dissolved U other________________
Detection limit(s):   <________   <________   <________

7. CONSTITUENT INFORMATION

7.05 METALS AND TRACE ELEMENTS (page 2 of 3)

Chromium Cr: Y N Reported: total dissolved U other________________
Detection limit(s): <________ <________ <________

Cobalt Co: Y N Reported: total dissolved U other__________________
Detection limit(s): <________ <________ <________

Copper Cu: Y N Reported: total dissolved U other__________________
Detection limit(s): <________ <________ <________

Gold Au: Y N Reported: total dissolved U other____________________
Detection limit(s): <________ <________ <________

Indium In: Y N Reported: total dissolved U other__________________
Detection limit(s): <________ <________ <________

Iodine I: Y N Reported: total dissolved U other__________________
Detection limit(s): <________ <________ <________

Iron Fe: Y N Reported: total dissolved U other____________________
Detection limit(s): <________ <________ <________

Lanthanum La: Y N Reported: total dissolved U other_______________
Detection limit(s): <________ <________ <________

Lead Pb: Y N Reported: total dissolved U other____________________
Detection limit(s): <________ <________ <________

Lithium Li: Y N Reported: total dissolved U other_________________
Detection limit(s): <________ <________ <________

Mercury Hg: Y N Reported: total dissolved U other_________________
Detection limit(s): <________ <________ <________

Molybdenum Mo: Y N Reported: total dissolved U other______________
Detection limit(s): <________ <________ <________

Nickel Ni: Y N Reported: total dissolved U other__________________
Detection limit(s): <________ <________ <________

Palladium Pd: Y N Reported: total dissolved U other_______________
Detection limit(s): <________ <________ <________

Platinum Pt: Y N Reported: total dissolved U other________________
Detection limit(s): <________ <________ <________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.05 METALS AND TRACE ELEMENTS (page 3 of 3)

Rhodium Rh: Y N Reported: total dissolved U other________________
Detection limit(s): <________ <________ <________

Rubidium Rb: Y N Reported: total dissolved U other_______________
Detection limit(s): <________ <________ <________

Selenium Se: Y N Reported: total dissolved U other_______________
Detection limit(s): <________ <________ <________

Silver Ag: Y N Reported: total dissolved U other_________________
Detection limit(s): <________ <________ <________

Strontium Sr: Y N Reported: total dissolved U other______________
Detection limit(s): <________ <________ <________

Tellurium Te: Y N Reported: total dissolved U other______________
Detection limit(s): <________ <________ <________

Tin Sn: Y N Reported: total dissolved U other____________________
Detection limit(s): <________ <________ <________

Titanium Ti: Y N Reported: total dissolved U other_______________
Detection limit(s): <________ <________ <________

Thallium Tl: Y N Reported: total dissolved U other_______________
Detection limit(s): <________ <________ <________

Vanadium V: Y N Reported: total dissolved U other________________
Detection limit(s): <________ <________ <________

Zinc Zn: Y N Reported: total dissolved U other___________________
Detection limit(s): <________ <________ <________

Zirconium Zr: Y N Reported: total dissolved U other______________
Detection limit(s): <________ <________ <________

Radioactive elements: Y N ____

Reported: total dissolved U other__________________________________

Detection limit(s): <________ <________ <________

Detection limit(s): <________ <________ <________

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

7. CONSTITUENT INFORMATION

7.06 SOLIDS, SEDIMENT, TURBIDITY (page 1 of 2)

Sampling: automatic manual U comment: ________________________________

Isokinetic: Y N U comment: ______________________________________

If automatic or grab, calibrated to isokinetic?: Y N U

Space: discrete composite U comment: ______________________________

Time: discrete composite U comment: ______________________________

Sampler type: ____

Nozzle sizes: ____

Transit rate: ____

Depth (stage): ____

Flow rate: measured from rating other: __________________________

Sampled whole hydrograph: Y N U comment: ______________________

Methods: ____

____

Standard field forms: Y N U comment: __________________________

Name of sediment laboratory used: _________________________________

____

Certified: ____

Depths at which samples taken: ___________________________________

Duplicates: Y N U comment: ____________________________________

Calibrate sampling personnel: Y N U comment: ___________________

Turbidity: Y N manual automatic/real-time

Maintenance/cleaning interval: ____________ Calibration: _________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.06 SOLIDS, SEDIMENT, AND TURBIDITY (page 2 of 2)

Total Solids (TS): Y N units: ___________________________________

Method: ____

Total Dissolved Solids (TDS): Y N units: _______________________

Method: ____

Total Suspended Solids (TSS): Y N units:_________________________

Method: ____

Suspended Solids (SS): Y N units:________________________________

Method: ____

Volatile Dissolved Solids (VDS): Y N units: ____________________

Method: ____

Volatile Suspended Solids (VSS): Y N units: ____________________

Method: ____

Total Volatile Solids (TVS): Y N units: ________________________

Method: ____

Suspended-matter size distribution information: Y N U

Specification: dissolved colloidal suspended settleable

How reported: ____

Sediment: bottom/bed-material soil sweepings dust dredge

Grain size: Y N U **Chemical:** Y N U **Age dating:** Y N U

comment: ____

How collected: ____

Other: (residue settleable matter floatable solids etc.) ______

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

7. CONSTITUENT INFORMATION

7.07 OXYGEN DEMAND (page 1 of 1)

BOD (unspecified): Y N U comment: ________________________________

BOD5: Y N U comment: ________________________________

BOD20: Y N U comment: ________________________________

COD: Y N U comment: ________________________________

THOD (theoretical oxygen demand): Y N U comment: __________________

____

UOD (ultimate oxygen demand): Y N U comment:_______________________

____

Other: ____

____

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 1 of 18)

Sampler type:____

Materials (sampling): ____

Manual or auto: ____

Discrete or composite: ____

Where in the flow: ____

Precleaned sampler: Y N U comment: ________________________________

Container material: ____

Sample location volatilization (sampled after falling water): Y N U

Sampler volatilization (i.e. ISCO utilizes suction): Y N U

Total Organic Carbon (TOC): Y N __________________________________

Dissolved Organic Carbon (DOC): Y N ______________________________

Rubber: Y N ____

Oil and grease: Y N ____

Hydrocarbons (HC): Y N ____

____

PCB's: Y N U ____

____

Semivolatile Organic Compounds (SVOCs): Y N U
pages 2-7 (of 18)

Polyaromatic Hydrocarbons (PAHs, a class of SVOC): Y N U
pages 8-11 (of 18)

Volatile Organic Compounds (VOCs): Y N U
pages 12-17 (of 18)

Fuel-related VOCs (BTEX and oxygenates): Y N U
page 18 (of 18)

Other Organic Compounds: Y N U
page 18 (of 18)

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 2 of 18) SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Acidrine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

c8-Alkyphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Anthraquinone: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Azobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzidine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,2'-Biquinoline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

bis(2-Chloroethoxy)methane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

bis(2-Chloroethyl)ether: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

bis(2-Chloroisopropyl)ether: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

bis(2-Ethylhexyl)phthalate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

bis(chloromethyl)ether: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

4-Bromophenyl-phenylether: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 3 of 18) SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Butylbenzylphthalate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

9H-Carbazole: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

P-Chloroaniline (4-Chloroaniline): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

4-Chloro-3-methylphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Chloronaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Chlorophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

4-Cholrophenyl-phenylether: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

o-Cresol (2-Methylphenol): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

p-Cresol (4-Methylphenol): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2-Dichlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,3-Dichlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 4 of 18) SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

1,4-Dichlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

3,3-Dichlorobenzidine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4-Dichlorophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Diethylphthalate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dimethyl nitrosamine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2-Dimethylnaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,6-Dimethylnaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,6-Dimethylnaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4-Dimethylphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

3,5-Dimethylphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dimethylphthalate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Di-n-butylphthalate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer’s Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 5 of 18) SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

4,6-Dinitro-2-methylphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

**4,6-Dinitro-o-cresol (4,6-Dinitro-ortho-cresol,
4,6-Dinitroorthocresol) :** Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4-Dinitrophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4-Dinitrotoluene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,6-Dinitrotoluene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Di-n-octylphthalate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Di-n-propyl nitrosamine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2-Diphenyl hydrazine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Hexachlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Hexachlorobutadiene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Hexachlorocyclopentadiene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Hexachloroethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 6 of 18) SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

Isophorone: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Isoquinoline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

m-Nitroaniline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

o-Nitroaniline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

p-Nitroaniline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Nitrobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Nitrophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

4-Nitrophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

n-Nitrosodi-n-propylamine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

n-Nitrosodiphenylamine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

n-Nitrosodimethylamine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

p-chloro-m-cresol (same as Parachlorometa cresol): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 7 of 18) SEMIVOLATILE ORGANIC COMPOUNDS (SVOCs)

P-chloro-toluene (Parachlorotoluene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Pentachloroanisole: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Pentachloronitrobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Pentachlorophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Phenanthridine: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Phenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,3,5,6-Tetramethylphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4,5-Trichlorophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4,6-Trichlorophenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,3,6-Trimethylnaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2,4,6-Trimethylphenol: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer’s Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 8 of 18) PAHs (A class of SEMIVOLATILE ORGANICS)

Polyaromatic hydrocarbons (PAHs): Y N U

Total polyaromatic hydrocarbons (PAHs): Y N U

Acenaphthene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Acenaphthylene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Anthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benz(a)anthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(a)pyrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(b)fluoranthene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(b)fluorene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(c)cinnoline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(c)phenanthrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(e)pyrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(ghi)fluoranthrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 9 of 18) PAHs (A class of SEMIVOLATILE ORGANICS)

Benzo(ghi)perylene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(j)fluoranthrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzo(k)fluoranthene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

(beta)-Chlornaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Biphyenyl: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Chrysene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Coronene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Cyclopenta(cd)pyrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dibenz(a,h)anthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2,3,4/1,2,5,6-Dibenzanthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dibenzothiophene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

9,10-Dimethylanthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 10 of 18) PAHs (A class of SEMIVOLATILE ORGANICS)

Dimethyl/ethyl phenanthrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Ethlynaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Fluoranthene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Flourene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Indene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Indeno(1,2,3-cd)pyrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1-Methylanthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Methylanthracene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Methylchyrsene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1-Methylnaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Methlynapthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1-Methylphenanthrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer’s Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 11 of 18) PAHs (A class of SEMIVOLATILE ORGANICS)

Methyl pyrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Naphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Quinoline: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Perylene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Phenanthrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Pyrene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2,3,4,-Tetrahydronapthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Tetramethylnaphthalene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 12 of 18) VOLATILE ORGANIC COMPOUNDS (VOCs)

Acetone (2-Propanone):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Acrolein (2-Propenal):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Acrylonitrile (2-Propenenitrile):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Bromobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Bromochloromethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Bromodichloromethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Bromoform (Tribromomethane):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

n-Butylbenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

sec-Butylbenzene (1-Methylproply benzene):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

tert-Butylbenzene (1,1-Dimethylethyl benzene):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Carbon tetrachloride (Tetrachloromethane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Chlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 13 of 18) VOLATILE ORGANIC COMPOUNDS (VOCs)

Chlorodibromomethane (Dibromochloromethane):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Chloroethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Chloroethyl vinyl ether: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Chloroform (Trichloromethane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Methyl chloride (Chloromethane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

0-Chlorotoluene (1-Chloro-2-Methylbenzene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2-Chlorotoluene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,4-Chlorotoluene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dibromochloropropane (1,2-Dibromo-3-chloropropane):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2-Dibromoethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dibromomethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Dichlorobromomethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 14 of 18) VOLATILE ORGANIC COMPOUNDS (VOCs)

Dichlorodiflouromethane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

1,1-Dichloroethane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

1,2-Dichloroethane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

1,1-Dichloroethene: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

cis-1,2-Dichloroethene: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

trans-1,2-Dichloroethene: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

Dichloromethane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

1,2-Dichloropropane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

1,3-Dichloropropane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

2,2-Dichloropropane: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

1,1-Dichloropropene: Y N
Reported: total dissolved U other___________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 15 of 18) VOLATILE ORGANIC COMPOUNDS (VOCs)

1,3-Dichloropropene (isomer not specified):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

cis-1,3-Dichloropropene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

trans-1,3-Dichloropropene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Hexachlorobutadiene (1,1,2,3,4,4-Hexachloro-1,3-butadiene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

2-Hexanone: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Isopropylbenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

P-Isopropyltoulene (1-Isopropyl-4-methylbenzene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Mesitylene (1,3,5 trimethyl benzene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Methyl ethyl ketone (2-Butanone):   Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Methyl bromide (Bromomethane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Methylene chloride (Dichloromethane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Methylisobutylketone (4-Methyl-2-pentanone): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <__________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 16 of 18) VOLATILE ORGANIC COMPOUNDS (VOCs)

Parachlorotoluene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

n-Propylbenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,1,1,2-Tetrachloroethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,1,2,2-Tetrachloroethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Tetrachloroethylene (Tetrachloroethene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2,3-Trichlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2,4-Trichlorobenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,1,1-Trichloroethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,1,2-Trichloroethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Trichloroethylene (Trichloroethene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Trichloroflouromethane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2,3-Trichloropropane: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 17 of 18) VOLATILE ORGANIC COMPOUNDS (VOCs)

Trichlorotriflouromethane (1,1,2-Trichloro-1,2,2-trifluoroethane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Trimethylbenzene (isomer not specified): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,2,4-Trimethlybenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

1,3,5-Trimethylbenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Vinyl acetate: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Vinyl chloride (Chloroethene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.08 ORGANICS (page 18 of 18) FUEL RELATED VOCs Y N U

BTEX:(Total BTEX Fuel Organics): Y N U
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Benzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Ethylbenzene: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Styrene (Ethenylbenzene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Toluene (Methylbenzene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Xylenes (isomers - 1,2-Dimethylbenzene: Y N
1,3-Dimethylbenzene: Y N
1,4-Dimethylbenzene): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

FUEL OXYGENATES

MTBE Methyl *tert*-butyl ether (2-Methoxy-2-methylpropane): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Alcohols: Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

OTHER ORGANICS

MBAS Methylene-blue-active-substance (surfactants): Y N
Reported: total dissolved U other_________________________________
Detection limit(s):<___________ <___________

Other: ____

____

____

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 1 of 11)

Seasons sampled: spring summer autumn winter

Sampling frequency: ____

If highway, site-maintenance schedule: ____________________________

____

Sampling after application: ______________________________________

____

Methods: ____

____

Materials (sampling): ____

____

Matrix used: ____

____

Insecticides: Y N U
pages 2-6 (of 11)

Herbicides: Y N U
pages 7-9 (of 11)

Fungicides: Y N U
page 9 (of 11)

Transformation products: Y N U
pages 10-11 (of 11)

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 2 of 11) INSECTICIDES

ORGANOCHLORIDE COMPOUNDS: Y N U

Aldrin: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________ <___________

Chlordane: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

DDT: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________ <___________

Dieldrin: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Endosulfan: Y N Reported: total dissolved U other________________
Detection limit(s):<___________ <___________

Endrin: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________ <___________

HCH: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________ <___________

Heptachlor: Y N Reported: total dissolved U other________________
Detection limit(s):<___________ <___________

Kepone: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________ <___________

Methoxychlor: Y N Reported: total dissolved U other______________
Detection limit(s):<___________ <___________

Mirex: Y N Reported: total dissolved U other_____________________
Detection limit(s):<___________ <___________

Perthane: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Toxaphene: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

ORGANOPHOSPHOSPHORUS COMPOUNDS: Y N U

Azinphos-methyl: Y N Reported: total dissolved U other___________
Detection limit(s):<___________ <___________

Chlorpyrifos: Y N Reported: total dissolved U other______________
Detection limit(s):<___________ <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 3 of 11) INSECTICIDES

Crufomate: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

DEF: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________ <___________

Diazinon: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Dichlorvos (DDVP): Y N Reported: total dissolved U other_________
Detection limit(s):<___________ <___________

Dimethoate: Y N Reported: total dissolved U other________________
Detection limit(s):<___________ <___________

Disulfoton: Y N Reported: total dissolved U other________________
Detection limit(s):<___________ <___________

Disyston: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Ethion: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________ <___________

Ethoprop: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Fenitrothion: Y N Reported: total dissolved U other______________
Detection limit(s):<___________ <___________

Fensulfothion: Y N Reported: total dissolved U other_____________
Detection limit(s):<___________ <___________

Fenthion: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Fonofos: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________ <___________

Imidan: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________ <___________

Malathion: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

Methamidophos: Y N Reported: total dissolved U other_____________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 4 of 11) INSECTICIDES

Methidathion: Y N Reported: total dissolved U other______________
Detection limit(s):<___________ <___________

Methyl parathion: Y N Reported: total dissolved U other__________
Detection limit(s):<___________ <___________

Methyl trithion: Y N Reported: total dissolved U other___________
Detection limit(s):<___________ <___________

Parathion: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

Phorate: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________ <___________

Phosphamidon: Y N Reported: total dissolved U other______________
Detection limit(s):<___________ <___________

Ronnel: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________ <___________

Sulprofos: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

Terbufos: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Trithion: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

OTHER INSECTICIDES: Y N U

Aldicarb: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Alpha-BHC: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

Aroclor (PCB) (any/all): Y N Reported: total dissolved U other___
Detection limit(s):<___________ <___________

Beta-BHC: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

Carbaryl: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________ <___________

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 5 of 11) INSECTICIDES

Carbofuran: Y N Reported: total dissolved U other________________
Detection limit(s):<___________ <___________

Delta-BHC: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________ <___________

Deet: Y N Reported: total dissolved U other______________________
Detection limit(s):<___________ <___________

Dibenzofuran: Y N Reported: total dissolved U other______________
Detection limit(s):<___________ <___________

Dibutylin: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Fenvalerate: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Dibutylin: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Fenvalerate: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Deet: Y N Reported: total dissolved U other______________________
Detection limit(s):<___________ <___________

Dibutylin: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Fenvalerate: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Lindane (Gamma-BHC): Y N Reported: total dissolved U other_______
Detection limit(s):<___________   <___________

Methomyl: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Oxamyl: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________   <___________

Permethrin: Y N Reported: total dissolved U other________________
Detection limit(s):<___________   <___________

Propargite: Y N Reported: total dissolved U other________________
Detection limit(s):<___________   <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 6 of 11) INSECTICIDES

Tributylin (TBT): Y N Reported: total dissolved U other__________
Detection limit(s):<___________   <___________

Other Insecticides: ____

____

____

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 7 of 11)   HERBICIDES

TRIAZINES AND ACETILIDES: Y N U

Acrolein: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Alachlor: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Ametryn: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

Atratone: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Atrazine: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Cyanazine: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Cyprazine: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Hexazinone: Y N Reported: total dissolved U other________________
Detection limit(s):<___________   <___________

Metolachlor: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Metribuzin: Y N Reported: total dissolved U other________________
Detection limit(s):<___________   <___________

Prometon: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Prometryn: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Propachlor: Y N Reported: total dissolved U other________________
Detection limit(s):<___________   <___________

Propazine: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

Simazine: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 8 of 11) HERBICIDES

Simetone: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Simetryn: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Terbutryn: Y N Reported: total dissolved U other_________________
Detection limit(s):<___________   <___________

PHENOXY ACIDS: Y N U

2,4-D: Y N Reported: total dissolved U other_____________________
Detection limit(s):<___________   <___________

2,4-D (methyl ester): Y N Reported: total dissolved U other______
Detection limit(s):<___________   <___________

2,4-DP: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________   <___________

2,4,5-T: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

2,4,5-TP (Silvex): Y N Reported: total dissolved U other_________
Detection limit(s):<___________   <___________

OTHER HERBICIDES: Y N U

Bensulfron-methyl: Y N Reported: total dissolved U other_________
Detection limit(s):<___________   <___________

Butylate: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Chloramben: Y N Reported: total dissolved U other________________
Detection limit(s):<___________   <___________

Dacthal: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

Dicamba: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

Dinoseb: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

Diquat: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________   <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 9 of 11) HERBICIDES

EPTC: Y N Reported: total dissolved U other______________________
Detection limit(s):<___________   <___________

Fluometuron: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Linuron: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

Molinate: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Norflurazon: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Paraquat: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Pendimethalin: Y N Reported: total dissolved U other_____________
Detection limit(s):<___________   <___________

Picloram: Y N Reported: total dissolved U other__________________
Detection limit(s):<___________   <___________

Propham: Y N Reported: total dissolved U other___________________
Detection limit(s):<___________   <___________

Thiobencarb: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Trifluralin: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

FUNGICIDES: Y N U

Captan: Y N Reported: total dissolved U other____________________
Detection limit(s):<___________   <___________

Chlorothalonil: Y N Reported: total dissolved U other___________
Detection limit(s):<___________   <___________

HCB: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________   <___________

PCNB: Y N Reported: total dissolved U other______________________
Detection limit(s):<___________   <___________

PCP: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________   <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 10 of 11) TRANSFORMATION PRODUCTS

Azinphos-methyl oxon: Y N Reported: total dissolved U other______
Detection limit(s):<___________   <___________

Carbofuran phenol: Y N Reported: total dissolved U other_________
Detection limit(s):<___________   <___________

2-Chloro-2',6'-diethylacetanilide: Y N Reported: total dissolved U
other ____
Detection limit(s):<___________   <___________

Cyanazine amide: Y N Reported: total dissolved U other___________
Detection limit(s):<___________   <___________

DDD: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________   <___________

DDE: Y N Reported: total dissolved U other_______________________
Detection limit(s):<___________   <___________

Deethylatrazine: Y N Reported: total dissolved U other___________
Detection limit(s):<___________   <___________

Deisopropylatrazine: Y N Reported: total dissolved U other_______
Detection limit(s):<___________   <___________

Desmethyl norflurazon: Y N Reported: total dissolved U other_____
Detection limit(s):<___________   <___________

Endosulfan sulfate: Y N Reported: total dissolved U other________
Detection limit(s):<___________   <___________

Endrin aldehyde: Y N Reported: total dissolved U other___________
Detection limit(s):<___________   <___________

ESA : Y N Reported: total dissolved U other______________________
Detection limit(s):<___________   <___________

Heptachlor epoxide: Y N Reported: total dissolved U other________
Detection limit(s):<___________   <___________

2-Hydroxy-2',6'-diethylacetanilide: Y N Reported: total dissolved
U other____
Detection limit(s):<___________   <___________

2-Kemolinate: Y N Reported: total dissolved U other______________
Detection limit(s):<___________   <___________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

7. CONSTITUENT INFORMATION

7.09 PESTICIDES AND HERBICIDES (page 11 of 11) TRANSFORMATION PRODUCTS

4-Kemolinate: Y N Reported: total dissolved U other_____________
Detection limit(s):<___________   <___________

Oxychlordane: Y N Reported: total dissolved U other_____________
Detection limit(s):<___________   <___________

Paranitrophenol: Y N Reported: total dissolved U other__________
Detection limit(s):<___________   <___________

Photomirex: Y N Reported: total dissolved U other_______________
Detection limit(s):<___________   <___________

Terbufos sulfone: Y N Reported: total dissolved U other_________
Detection limit(s):<___________   <___________

Other: ____

____

____

____

____

7. CONSTITUENT INFORMATION

7.10 MICROBIOLOGY

Equipment sterilization methods: _________________________________

Sterile technique: ____

Collection method: grab depth/width-integrated other: _____________

____

Sample preservation and storage: __________________________________

____

Holding times: ____

Total coliforms: Y N U units: ____________________________________

Culture media:____

Fecal coliforms: Y N U units: ____________________________________

Culture media: ____

Escherichia coli: Y N U units:____________________________________

Culture media: ____

Fecal Streptococcus: Y N U units:_________________________________

Culture media: ____

Other: Y N U units: ____

Culture media: ____

Other: Y N U units: ____

Culture media: ____

Other: Y N U units: ____

Culture media: ____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

7. CONSTITUENT INFORMATION

7.11 EUTROPHICATION

Secchi disk: Y N comment: ____

Chlorophyll: Y N comment: ____

Species composition: Y N comment: _________________________________

Macrophyte density: Y N comment: __________________________________

Water balance (source of inputs and outputs): _____________________

Maximum depth: ___________________ **Mean depth:** ___________________

Basin characteristics: ____

____

Profiles: Y N Type: ____

____

Other: ____

____

____

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______   Report _____

7. CONSTITUENT INFORMATION

7.12 BIOLOGICAL PARAMETERS (page 1 of 2)

Sample Site Characteristics: ______________________________________

Water-management features: Y N bridge channelized-area diversion feedlot hydropower impoundment industrial-outflow low-head-dam natural-lake storm-sewer streambank-stabilization thermal-discharge wastewater-treatment other _____________________

Stream type: Y N order straight meandering braided channelized pool/riffle segment gradient channel sinuosity other ____

Geomorphic channel unit: Y N pool riffle run length other ____

Bed substrate: Y N bedrock boulder cobble gravel sand silt hardpan marl detritus muck artificial

Available light features: Y N canopy angel aspect (compass direction) other ____

Habitat features: Y N (woody-snags overhang-vegetation undercut-banks boulders sloughs macrophytes-emergent(plants stick out) macrophytes-submerged macrophytes-floating rubbish—human produced none) ___________________________________

Geomorphic features: Y N (bar/shelf/island bank-angle bank-height bank-vegetation-stability bank-erosion bank-substrate bank-woody vegetation channel-width stage flood-plain-width velocity embeddedness) ____

Diagrammatic mapping: Y N comment: _____________________________

Aquatic and riparian vegetation species: Y N

Biotic Community Assessment: Y N __________________________________

Species: ____

____

Collection method: ____

Collection device: ____

____

NDAMS DATA REVIEW SHEET   **Reviewer's Initials** _______ **Report** _____

7. CONSTITUENT INFORMATION

7.12 BIOLOGICAL PARAMETERS (page 2 of 2)

Biological fluid and tissue analysis (Histopathology): Y N

Collection method: ____

____

Collection device: ____

____

What Biota sampled: (aquatic macrophytes, algae, microinvertebrates, macroinvertebrates, vertebrates (fish, amphibians, reptiles, other animals/people)):____

____

____

Analytes: ____

____

____

____

Semi-Permeable Membrane Devices: Y N

Metal Sequestration and Regulation (methallothioneins): Y N

Oxidative Metabolism: Y N

Reproductive Parameters: Y N

NDAMS DATA REVIEW SHEET **Reviewer's Initials ________** **Report ______**

7. CONSTITUENT INFORMATION

7.13 TOXICITY TESTING

Toxicity tests lab: Y N Species: ________________________________

____

Water: lab natural other: ____________________________________

Conditions: ____

____

Method: ____

Toxicity tests field (in situ): Y N Species: ____________________

____

Water: lab natural other: ____________________________________

Conditions: ____

____

Method: ____

Microbial Assays: Y N

Algal Assays: Y N

Aquatic Invertebrate Assays: Y N

Early life-stage toxicity (fish): Y N

7. CONSTITUENT INFORMATION

7.14 OTHER

Other: ____

____

____

____

____

____

____

____

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

8. SAMPLING FOCUS AND MATRIX (page 1 of 2)

Physical Focus:

Highway/road: Y N pavement-edge(gutter) catchbasin/gullypot

shoulders/median drainage pipe other/comment: ___________________

BMP: Y N type: ____

inlet forebay center outlet other :____________________________

Combined sewer: Y N ____

Storm drain: Y N in pipe at lip spillway

comment: ____

Stream/river: Y N upstream at discharge downstream

comment: ____

Wetland: Y N ____

Lake/pond (not BMP pond): Y N __________________________________

Coastal water: Y N ____

Unknown: Y N ____

Hydrologic Focus:

Surface water: Y N ____

Unsaturated zone: Y N upgradient at discharge downgradient

comment: ____

Ground water: Y N upgradient at discharge downgradient

comment: ____

Atmospheric deposition: Y N ____________________________________

wet dry rain snow fog air dust aerosols other:_____________

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

8. SAMPLING FOCUS AND MATRIX (page 2 of 2)

Matrix:

Biota: Y N ____

What sampled: ____

Water: Y N ____

whole water suspended-solids dissolved(filtered-water) colloids

filter residue unknown

If filtered water: Pore size: __________ Filter type: __________

Brand: ________________ Diameter/size: __________________________

Material : ____

Sediment: Y N ____

total-total(dissolved by acid) sand fraction(>63 microns)

silt/clay(<63 microns) bed-load sediment-cores

bottom/bed material soil sediment dust dredge unknown

other: ____

Air or gas emissions: Y N ______________________________________

____

Other matrix: ____

____

____

____

____

9. FLOW-MONITORING METHODS (page 1 of 2)

Where measured in relation to QW samples: _________________________

____

Where: precipitation evaporation sheet-flow
surface-water unsaturated-zone groundwater other: ______________

SURFACE WATER: Y N U

Flow: measured estimated

Channel type: river stream pipe swale human-made-channel
sheet-flow-pavement sheet-flow-soil sheet-flow-vegetation
overland-flow-pavement overland-flow-soil overland-flow-vegetation
other: ____

Stage: Y N U Type: _______________________ Resolution: _______

Discharge: Y N U Type: ___________________ Resolution: _______

Velocity: Y N U Type: ___________________ Resolution: _______

Hydraulic controls: Y N U

Type: weir flume other: ____

Maintained/cleaned: Y N U

Rating: measured estimated theoretical U

Rating verified independently: Y N how: ________________________

____

Personnel trained and experienced: Y N U

Uncertainty of flow calculation: __________________________________

Flow (flux) measured: Y N U

Frequency of stage measurements: __________________________________

Automated monitoring: Y N U

System type instruments: ____

Appropriate calibrated functioning-in-design ranges: Y N U

9. FLOW MONITORING METHODS (page 2 of 2)

GROUND WATER: Y N U

Geologic materials: bedrock karst till sand-and-gravel

other: ____

Confined vs unconfined: confined unconfined

Hydraulic conductivity: slug-test area-pump-test

localized-pump-test grain-size-analysis permeameter

other:____

Continuous water-level recorder: Y N U

Water Level Method: steel-tape/chalk electric-beeper

Water-level accuracy: ____

PRECIPITATION: Y N U

What monitored: rain snow ice other: ___________________________

Data source: existing-network study-network study-site

Distance from QW sites to precipitation sites:

<1000 ft <1mi <10mi >10mi

Measured: totals intensity

Interval: sec min hourly daily other: ________________________

How measured: auto manual both

Gage heated: Y N U

If gage heated: fuel electric other: ___________________________

Method: ____

Other flow-related data: ____

____

NDAMS DATA REVIEW SHEET **Reviewer's Initials** _______ **Report** _____

10. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) FIELD

Trained professional sampling team: Y N U

comment: ____

Field sampling and processing QA/QC plan: Y N

Published: Y N U ____

Reference: ____

____

Intra office or independent QA/QC audit/review: Y N U

Review verification and approval of data before release: Y N U

Review (technical) of field and lab methodologies: Y N U

Calibration of field instruments: Y N U

Sample containers certified clean: Y N U

Sample container blanks: Y N U

Preservative QA/QC: Y N U

Filter QA/QC: Y N U

Field/trip blank: Y N U **Verified blank water:** Y N U

Equipment blanks: Y N U **Verified blank water:** Y N U

Field matrix spike (recovery): Y N U ___________________________

Field reagent spike (recovery): Y N U __________________________

Blind/reference Sample (known conc.): Y N U ____________________

Split replicates--from same sample (unknown conc.): Y N U _______

Concurrent replicates--from 2 samples at same time: Y N U ______

Sequential replicates--collected within minutes: Y N U __________

Method replicates: Y N U ______________________________________

Sampling team replicates: Y N U _______________________________

Equipment replicates: Y N U ___________________________________

NDAMS DATA REVIEW SHEET **Reviewer’s Initials** _______ **Report** _____

11. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) LABORATORY

Accredited lab: Y N U Accreditation: __________________________

Trained professional analysis team: Y N U

comment: ____

Participates in interlaboratory comparison: Y N U

EPA water supply study EPA water pollution study Canadian inland water study USGS BTDQS study NOAA study

External methods / QA/QC audits: Y N U ________________________

Program: ____

Quality-assurance/Quality-control plan: Y N U ___________________

Published: Y N U ____

Reference: ____

____

Sample holding period time monitored: Y N U

Sample holding period storage monitored: Y N U

Data entry and validation control: Y N U

Instrument calibration: Y N U

Method check (with standards): Y N U

Method check (with replicates): Y N U

Reagent control: Y N U

Blind sample program: Y N U

External blind sample program: Y N U

Field/lab QC: Y N U

Lab matrix spike (recovery): Y N U ______________________

Lab reagent spike (recovery): Y N U ______________________

Intralab replicates: Y N U ______________________________

NDAMS DATA REVIEW SHEET   Reviewer's Initials _______ Report _____

12. UNCERTAINTY ANALYSIS/ERROR ANALYSIS

Uncertainty/Error (U/E)

U/E specifically expressed: Y N U

significant-digits population-stats percent-error tolerance(±)

U/E implicitly expressed: Y N U

significant-digits population-stats percent-error tolerance(±)

If U/E expressed:

U/E of how representative is the study site: Y N U _____________

U/E of field methods: Y N U ____________________________________

U/E of field instruments: Y N U ________________________________

U/E of laboratory analysis: Y N U _______________________________

U/E of stage measurement: Y N U ________________________________

U/E of velocity measurement: Y N U _____________________________

U/E of precipitation measurement: Y N U ________________________

U/E of calculated results: Y N U _______________________________

U/E of model results: Y N U ____________________________________

Other: ____

Appendix 3

Appendix 3 – National Data and Methodology Synthesis Review Instructions

FOREWORD

The purpose of this appendix is to provide systematic documentation of the process used to review each article or report. The process is based on the National Data and Methodology Synthesis (NDAMS) review sheet. The NDAMS review sheet and the review process were designed to document data and information that are needed to determine whether each report reviewed will meet various criteria to establish that the published results are valid (useful for intended purposes), current, and technically defensible.

The NDAMS review sheet instructions were designed to provide enough detailed information for someone with a scientific or engineering background and a familiarity with water quality, highway-, and stormwater-runoff issues to use during a review. The NDAMS review sheet and the review process often require interpretive judgments to assess the publication being reviewed but do not depend upon a predetermined set of data-quality evaluation criteria. The reviewer must use interpretive judgments to translate published descriptions of study design, objectives, methods, equipment, and results into standard responses so that different sources of published information can be evaluated by using criteria that meet intended data-quality objectives. The reviewer, however, should not extrapolate beyond information provided in the published report because a lack of pertinent information is an important metadata characteristic when evaluating available reports for potential use in a quantitative national synthesis. Granato and others (1998) describe information requirements that are necessary for a national evaluation of highway runoff quality. Each item on the review form is defined as one or more of six data-evaluation criteria (accessibility, comparability, data quality, explanatory, repeatability, and legal requirements). These criteria are defined in glossary C (appendix 1), to communicate these concepts concisely in one place. Many of the terms that are commonly used to define the nature of the intended responses are defined in glossary B (appendix1).

The NDAMS review sheet has 12 sections, each designed to capture some aspect of the information required to evaluate any given data set for a potential use. These sections are as follows:

1. Review information
2. Investigation and report information
3. Temporal information
4. Location information
5. Water-quality-monitoring methods
6. Sample-handling methods
7. Constituent information
8. Sampling focus and matrix
9. Flow-monitoring methods
10. Quality assurance and quality control (QA/QC) field
11. Quality assurance and quality control (QA/QC) laboratory
12. Uncertainty analysis/error analysis

Additionally, section 7 is divided into 14 subsections for use in documenting the availability and data quality of information about individual water-quality constituents that are organized into functional groups of similar constituents.

The format of these instructions is based on version 4.0 of the NDAMS review sheet. U.S. Geological Survey (USGS) reviewers used version 2.0 to complete most of the reviews that are catalogued in the database. Version 4.0, however, is functionally the same as version 2.0, but version 4.0 also includes the addition of a few constituents that had not yet been classified during the review process and so were recorded under subsection 7.14 "Other constituents". The primary difference between the versions consists of editorial changes in formatting and grammar, and several minor changes for future use to facilitate data entry into a Microsoft Access database.

The instructions, which follow the review sheet item-by-item, are rather lengthy because the review sheet is 59 pages in length. The NDAMS review sheet is divided into 12 sections and 14 constituent-based subsections to facilitate the review process. Sections 1, 2, 7.0, and 8 are required for **all** reports. The other sections are only used when data or information from these sections are available in a report. Sections 1, 2, 7.0, and 8 are the only sections documented for summaries or literature reviews because more detailed data-quality information is not generally available in these types of reports. The water-quality constituent subsections 7.01-7.14 are required for all reports (other than summaries or literature reviews) that document constituents from the respective subsections. Temporal information (section 3), location information (section 4), water-quality-monitoring methods (section 5), and sample-handling methods (section 6) are required for most reports that are reviewed, but some information cannot be entered if the report contains insufficient documentation. If flow monitoring is documented, as indicated by a "yes" in section 2, the reviewer should complete section 9. If a Quality assurance and quality control (QA/QC) program is documented, as indicated by a “yes” in section 2, the reviewer should complete section 10 and (or) section 11 as appropriate. The reviewer should complete section 12 only if the report contains an uncertainty analysis and (or) error analysis as indicated by a “yes” in section 2.

The NDAMS review sheet was designed to facilitate standardization of the metadata documentation process for meaningful comparisons within and among available data sets. However, consideration was given to the need for the review process to evolve as well as to the need to document miscellaneous details and explanations that the reviewer deems necessary. Therefore, a menu of choices is provided for many data elements, but answers other than the listed choices can also be recorded on the underlined space next to “other.” Underlined spaces are provided for the reviewer to write in comments and record observations as appropriate.

The NDAMS review sheet instructions were designed as a reference document to be used in conjunction with glossaries A, B, and C (appendix 1) and the NDAMS review sheet (appendix 2). The NDAMS review sheet instructions were formatted systematically to facilitate use of this reference document in conjunction with the review forms. Repetitive statements appear throughout the instructions so that the definitions for each entry may be accessed individually in any order (such as in an instruction manual), rather than following a normal flow from beginning to end (such as in a report narrative). Many terms on the review sheets are abbreviated to conserve space, and these informal are reproduced in the instructions to facilitate comparison to the review sheet. Each major term on the review sheet is in bold print and is reproduced exactly in the instruction manual to maintain the consistency needed to cross reference the instructions with the review forms. Major terms are left justified. Related terms are indented, but remain in bold print. Additional entries for ancillary information are also indented, but are not bolded. When a term on the review sheet is to be completed using one or more multiple choice answers, a definition is given for each choice. Standard sets of choices (such as "yes," "no," or "unknown") are defined in glossary B (appendix 1). A unique set of choices for a term are defined directly following the term and are indented in an italicized, bulleted list. The choices are italicized herein (even though they are not italicized on the review sheet) to facilitate easy identification by the reader while scanning back and forth between the review forms and the instruction sheet. If an entry instruction contains a bolded term, the term is found on the NDAMS review sheet.

1. REVIEW INFORMATION

This section describes the report being reviewed, the reviewer, and other pertinent review information. In addition, this section can be used to classify or reclassify the subject of the report with a keyword code.

Reviewer. The person who reads the report, evaluates the information provided, and completes the NDAMS review sheet.

Hours. The amount of time, in hours, that the reviewer spent reading the report and completing the NDAMS review sheet.

Pages. The number of pages in the report.

Year. The year the report was published.

Code. A two-letter keyword code that classifies the subject of the report. The first letter identifies the major subject of the report and the second letter identifies the minor subject of the report. Some of the terms represented by the keyword code letters are defined in Glossary A (appendix 1). These terms are as follows:

- *A* – Atmospheric deposition
- *B* – Best management practices (BMPs)
- *C* – Chemistry
- *G* – Specific conductance
- *E* – Environmental effects
- *H* – Highway
- *M* – Sampling methods
- *O* – Other
- *Q* – Quality Assurance and Quality Control (QA/QC)
- *S* – Salt-deicing chemicals
- *T* – Total maximum daily loads (TMDLs)
- *U* – Urban

For example, a report coded HU indicates that the primary emphasis of the report is highway runoff and the secondary emphasis is urban runoff from the surrounding area. These keyword codes are designed to facilitate subject or topic searches in the NDAMS database.

Change code. Applies when the initial two-letter subject code is not the most suitable coding for the report. If, upon detailed review, it is determined that another code is more suitable, the reviewer can indicate that the code should be changed in the database. If the initial two-letter code is the most suitable, the reviewer should circle '*N*' for "No" and skip to the next section.

> **Why.** Explains the reason the code should be changed. For example, a report initially marked HH may, in fact, concentrate on the environmental effects of highway runoff and should be changed to EH or HE.

> **New code.** The revised subject classification, used if the reviewer determines the need for a more appropriate code.

First author. The primary contributor for the published report.

Report number. Corresponds to the report number (Citation_ID) that has been assigned to the report's reference in the database. Although the review sheet repeats this field at the top of each page, the reviewer does not need to complete this field during the review because the number is added to the form during entry of the information from each page of each review into the database.

Title. The title of the report.

2. INVESTIGATION AND REPORT INFORMATION

This section describes the general content of the report. Investigation and report information includes the scope of the study and characterization of the data available in the report.

First author affiliation. Identifies the company, university, agency, or other organization employing the first author during the study period. The author's affiliation usually is underneath the author's name or is in a note at the bottom of the first page of the publications reviewed. In some instances, when this information is not explicitly described, the reviewer can assume that the author is affiliated with the organization that published the report.

Report sponsorship. Identifies the government agency, company, university, or other organization that funded the project. This information is usually included in the acknowledgments of the report or on the cover page completing the phrase, "In cooperation with."

Purpose. Explains the reason the study was carried out. The authors usually state the purpose in the abstract or the introduction of the report.

Peer review. Applies to a citable published document that has been reviewed by technical reviewers outside of the author's immediate organizational unit (Intergovernmental Task Force on Monitoring Water Quality, 1995a,b). The reviewer may find it difficult to determine peer review status. Therefore, if the report affirmatively indicates that peer review occurred, the reviewer should circle '*Y*.' In some instances, the reviewer can assume that peer review occurred. Reports published by Federal agencies, such as the USGS, the USEPA, and the FHWA, generally have been peer reviewed. In addition, most journal articles undergo peer review. The reviewer also can provide comments to establish the assumptions made in answering this question.

Type of report. Refers to the following classifications of the report by content:

- *review/summary.* The report reviews and (or) summarizes previous studies on the subject; no new study results are discussed. If the report fits this classification, the reviewer only completes basic information sections 1, 2, 7.0, and 8 of the NDAMS review sheet.
- *data.* The report only presents data collected during a study; no data analysis is discussed.
- *data/interpretive*. The report presents data and data analysis. In some cases, data analysis may be provided without all of the original data being published.
- *methods.* The report emphasizes experimental or laboratory methods rather than the results of these methods.
- *modeling*. The report describes the model or modeling effort, and sometimes presents data used in a model application.

- *regulatory/management.* The report focuses on policy by emphasizing how data relate to existing or new policies.
- *monitoring/permit.* The report presents data collected as part of a required monitoring program or in order to obtain permits, or to satisfy some regulatory requirement.
- *guide.* The report presents instructions for the collection, monitoring, interpretation, or use of certain types of data and information, but does not include original research. A guide is usually part of a volume set, and the methods included are usually specific to a particular study.
- *other.* The report is a type not listed above.

Study location(s). Refers to the country, state, municipality, and (or) highway where the original study was conducted. Section 4 of the NDAMS review sheet contains more detail for each site. Therefore, this entry is designed to identify the general location of the study area.

Area of study. Refers to the geographical scale of the study.

- *point(s).* The report presents data from sites that only represent individual points, such as a particular highway drainage structure or individual drainage structures at different locations.
- *local.* The report presents data from sites integrating a local area, such as a town or city. The investigators designed the study to integrate and characterize the local area in question.
- *watershed.* The report presents data from sites in a specified watershed (defined in glossary A – appendix 1). Investigators designed the study to characterize the watershed identified in the report.
- *regional*. The report presents data from sites in a region that are identified in the report. Investigators designed the study to characterize the region.
- *national.* The report presents data from sites across a nation. Investigators designed the study to characterize the nation.
- *international.* The report presents data from sites in more than one nation. Investigators designed the study to characterize a multinational region or differences between countries.
- *other.* The report presents data from any area of study not listed above.

Number of study sites. Refers to the number of identified places where data were collected for a given study. In some cases, data may have been collected at numerous points within a small area, but the area is described as a single site. In these cases, the reviewer should classify the small area as one study site. However, if each point is described as a site, the reviewer should specify each point in the total number of sampling points. For example, if the report presents the data for each sampling point in tabular form, the reviewer should include each point as a study site, even if no further site identification is given. The number in this space should correspond to the total number of sites referred to in section 4 (Location Information) in the NDAMS review sheet. “Number of study sites” is a data-quality characteristic.

QA/QC program. Indicates if the study documented quality assurance and quality control (QA/QC) procedures (FHWA, 1986; defined in glossary A –appendix 1).

- *Y (yes).* This documents that the report mentions the QA/QC program in detail and describes what QA/QC techniques were applied. If the reviewer marks 'Y' here, the reviewer should complete section 10 (QA/QC field) and (or) section 11 (QA/QC laboratory).
- *N (no).* This indicates that the report does not document a QA/QC program.
- *U (unknown).* This indicates that the term appears in the report, such as "QA/QC was carried out," but no details of the program are documented in the report and the QA/QC procedures are unknown.

The reviewer also can provide a comment. "QA/QC program" is a comparability characteristic, a data-quality characteristic, and a repeatability characteristic.

Original data availability. Indicates whether the report contains original data for each sample collected in the study. Data summaries or averages do not qualify as original data.

- *Y (yes).* Indicates that the report contains original data.
- *N (no).* Indicates that the report does not contain original data.
- *U (unknown).* Indicates that the report refers to original data in another report, which is referenced, but the report being reviewed does not include original data. The reviewer should give the reference in the comment section.

The reviewer also can provide a comment. "Original data availability" is an accessibility characteristic and a comparability characteristic.

Data presentation. Refers to the manner in which data are presented in the report.

- *individual.* The report presents the data for individual sampling sites and by date and time.
- *summary.* The report presents the data as averages, other population statistics, or summary charts like histograms, and presents analyses of the combined data.
- *NA (not applicable).* The report does not present data.
- *other.* The report presents data in a manner other than those listed above.

"Data presentation" is an accessibility characteristic and a comparability characteristic.

Data form. Refers to the format used to present data in the report. The reviewer can select all of the following terms that apply.

- *graphic.* A graph, map, or other visual representation of the data (defined in glossary B – appendix 1).
- *table.* The presentation of data in tables and (or) lists.
- *NA (not applicable).* The report does not present data.
- *other.* The report presents data in a form not listed above.

"Data form" is an accessibility characteristic.

Electronic availability. Refers to the electronic format in which the data are available, such as a national database; a local, State, or Federal repository; or other accessible location. The reviewer can assume "yes" for USGS and USEPA reports because both organizations support national water-quality database structures. The reviewer should note the **format** of the electronic data. "Electronic availability" is an accessibility characteristic.

Uncertainty analysis. The quantitative analysis of the potential measurement error in the study results. It involves quantifying the error of the measurements taken in the study and calculating the final error of the results. Uncertainty analysis does not refer to general analysis of population statistics unless the variability of measurement methods also is documented and analyzed. Measurement error should not be confused with general population variance. If uncertainty analysis was done during the study, the reviewer should complete section 12 (uncertainty analysis/error analysis). "Uncertainty analysis" is a data-quality characteristic.

Indication of uncertainty. Refers to whether or not the report presents error for individual measurement components or indicates the expected uncertainty in final results without supporting documentation. If the report expresses uncertainty, the reviewer should complete section 12 (uncertainty analysis/error analysis). "Indication of uncertainty" is a data-quality characteristic.

Reported. This section is for the reviewer to indicate whether the report presents four different types of water data and how the study quantified the data.

> **Flow.** Refers to the time rate of volumetric movement of water. Other terms used to describe flow include flow rate and discharge. The dimensions of flow are [VOLUME/TIME]. Common units for reporting flow include cubic feet per second (ft^3/s), cubic meter per second (m^3/s), and gallons per day (gal/d). If flow data are documented in the report, the reviewer should complete section 9, to record different types of flow measurements, for surface water, ground water, and(or) precipitation as appropriate. The reviewer also should note the method for determining flow data by circling any or all of the following methods that apply: *measured*, *calculated*, *estimated.*

Concentrations. Refers to the quantity of the constituent per unit quantity of the sampling matrix. The dimensions of concentration are [MASS (of constituent)/VOLUME (of matrix)] or [MASS (of constituent)/MASS (of matrix)]. Common units in which concentration is reported include milligram per liter (mg/L), milligram per cubic meter (mg/m^3), parts per million (ppm), and milligram per kilogram (mg/kg). If the report contains concentration data, the reviewer also should note the method for determining concentration data by circling any or all of the following methods that apply: *measured, calculated, estimated.*

Storm loads. Refers to the total mass quantity of a constituent resulting from an individual storm. The dimensions of storm load are [MASS (of constituent)/AREA (drained)] or [MASS (of constituent)]. If the report contains storm load data, the reviewer also should note the method for determining storm load data by circling any or all of the following methods that apply: *calculated, estimated.*

Annual loads. Refers to the total mass quantity of a constituent occurring in a year. The dimensions of annual load are [MASS (of constituent)/AREA (drained)] or [MASS (of constituent)]. If the report contains annual load data, the reviewer also should note the method for determining annual load data by circling any or all of the following methods that apply: *calculated, estimated.*

"Reported" is a comparability characteristic and a data-quality characteristic.

Remarks. Provides space for the reviewer to comment on any of the section's general information categories.

Abstract. Refers to the path and filename of a file containing the abstract for governmental reports and a previa or summary (written by the reviewer) for copyrighted reports so the text can be imported into the abstracts table in the database.

Recommended further study. Documents recommendations by the author(s) for further study when indicated by report results.

Problems mentioned in study (by author). Refers to any problems that the author specifically mentions in the report pertaining to data collection, analysis, and (or) interpretation.

3. TEMPORAL INFORMATION

Documented temporal information is necessary to assess comparability of data and overall data quality. Temporal information provides documentation about the dates of, the frequency of, and the duration of the sampling effort.

Date(s) of field work (period of record). Refers to the month and year that field work began and ended. "Date(s) of field work" is a comparability characteristic and an explanatory characteristic.

> **Remarks.** Provides a space for the reviewer to write additional remarks about the dates of fieldwork, such as interruptions or deviations from the original schedule.

Months. Provides a more detailed account of when samples were collected and indicates seasonality in the sampling efforts. The months of sampling sometimes are included in tables listing the sampling results. If the months sampled vary from year to year in a study period, the reviewer can explain this in the comment section. "Months" is a comparability characteristic and an explanatory characteristic.

Number of sampling rounds. Indicates the total number of times samples were collected. If the number of sampling rounds is different per site or per matrix sampled, the reviewer can explain this in the comment section. Generally, the minimum number of sampling rounds can be written followed by a plus sign to indicate that there are variations between sites. For example, if three samples were collected at one site and five were collected at another, the reviewer can enter "3+" as the value and explain in the comments section. "Number of sampling rounds" is a data-quality characteristic.

Total number of storms. Indicates how many storms were sampled during the entire sampling period, as well as how many events per storm type were sampled. The reviewer can indicate the number of *rain* storms, *snow* storms, and snow/ice *melt* events. "Total number of storms" is an explanatory characteristic.

Antecedent dry period. The amount of time preceding a sampled storm in which there were no precipitation events. The antecedent dry period can be reported in report on a *by storm* basis, as an *average* for all storms sampled, or as a *range* of values for all storms sampled. "Antecedent dry period" is an explanatory characteristic.

Comments. Provides space for comments on any temporal information.

4. LOCATION INFORMATION

Documented location information is necessary to assess the repeatability of a study and comparability between study sites. Location information provides details about where the study was done as well as the geographical scale of the study.

Site name descriptor. The name of the site referred to in the report.

Location. Refers to the location where the study was conducted. Location information may include one or more of the following subcategories: **Country, State, Postal Abbreviation** (this refers to the two-letter postal abbreviation for one of the 50 States), **Province,** and **City/Town/County/Other.** "Location" is a repeatability characteristic.

Watershed. The local drainage basin in which the study site is located and which drains to a readily identifiable water course or water body. The reviewer should identify the watershed only as the author identifies it in the report and should not try to identify it independently. "Watershed" is a repeatability characteristic.

Highway, State, or Interstate route. Refers to the identification number of the highway, State, or interstate route (such as I-90 for Interstate 90) that is the subject of the study. "Highway, State, or Interstate route" is a repeatability characteristic.

Latitude and Longitude. Refers to the location of the study site as determined by the reviewer from information in the report. The reviewer can determine the latitude and longitude of the study site by

- extracting the information directly from the report text or table,
- using a detailed map with definable features, such as a USGS topographic map and (or) the location map from the report, and using a program for Point Location And Calculation of Error (PLACER) to automate the interpolation process (OFR 99-99).
- querying the World Wide Web for a location in the United States by using the USGS Geographical Names Information System (GNIS) to locate the generalized latitude and longitude location of a county, city, stream, or other feature (except specific street names) at the URL http://mapping.usgs.gov/www/gnis, or
- querying the World Wide Web for an international location by using the National Imagery and Mapping Agency (NIMA) GEOnet Names Server to locate the generalized latitude and longitude location of a province, city, stream, or other feature at the URL http://164.214.2.59/gns/html/index.html

"Latitude and Longitude" is an explanatory characteristic and a repeatability characteristic.

Accuracy. The expected uncertainty of the latitude and longitude values. Accuracy is the degree to which a measured value agrees with the value of the measured property (Jones, 1999). If the locations in a report are recorded in the USGS National Water System database, the recorded accuracy (typically 1 second) is recorded. If the report directly gives values for latitude and longitude, the accuracy of those values should be assessed on a case-by-case basis with supporting information, such as significant figures. If a report has a site map with latitude and longitude coordinates, or a number of features that are identifiable in an on-line geographical names database, site coordinates can be calculated by PLACER. In PLACER, the accuracy is calculated as the standard deviation of identifiable feature locations (Granato, 1999). When it is necessary to determine latitude and longitude coordinates indirectly, however, it is difficult to assess the accuracy of the estimated coordinates for each site. Ground rules for defining the uncertainty are established based upon the largest expected size for a political unit or a map feature. The following ground rules are used to conservatively estimate the accuracy of site coordinates:

- 15-minute accuracy for a city or town location from the GNIS,
- 30-minute accuracy for county locations from the GNIS,
- 30-minute accuracy for a river or stream location from the GNIS, and
- 30-minute accuracy for international locations from the NIMA GEOnet Names Server.

"Accuracy" is a data-quality characteristic.

Drainage area. The land area from which the surface water runoff drains to a sampling point. Drainage area is reported in square miles on the NDAMS review sheet for consistency, but is predominantly reported in acres for most highway studies. "Drainage area" is an explanatory characteristic.

Percent of watershed. The percentage of land area that the drainage basin occupies in the total watershed defined by the report. "Percent of watershed" is an explanatory characteristic.

Site land use. The primary use of the land on which the study site is located. For example, the samples could be collected from the side of a highway (*highway*), in a shopping mall parking lot (*commercial*), in a lake (*water*), and so forth. "Site land use" is an explanatory characteristic.

Surrounding land use. The primary use of the land located in close proximity to the study site. For example, for a sample collected from a lake in a residential neighborhood, the site land use would be *water* and the surrounding land use would be *suburban*. "Surrounding land use" is an explanatory characteristic.

Percent impervious. The percentage of the drainage area in the area of study that prevents infiltration of rainfall and, thus, increases surface runoff. Impervious land can be covered by asphalt, concrete, rooftops, and so forth. "Percent impervious" is an explanatory characteristic.

Percent pavement. The percentage of the drainage area in the area of study that is covered by pavement. "Percent pavement" is an explanatory characteristic.

Highway characteristics.

Lanes. The total number of highway lanes, in either direction, that are included in the study site drainage area. "Lanes" is an explanatory characteristic.

Length of road surface. The total length of the road surface that drains to the sampling point. "Length of road surface" is an explanatory characteristic.

Pavement type. The materials that cover the highway surface, such as concrete or asphalt. "Pavement type" is an explanatory characteristic.

Curbing. The barriers along the side of the highway that prevent surface runoff from draining to the adjacent land. "Curbing" is an explanatory characteristic.

Section. The local topography of the road section being studied.

- *level.* The road section is level with the surrounding land.
- *cut.* The road section is cut into a hillside.
- *fill.* The road section is constructed on an area of land that has been filled above its natural elevation.
- *cut-and-fill.* The road section is constructed with a combination of cut and fill areas.
- *bridge.* The road section includes a bridge.
- *other.* Types of road section not mentioned above or additional information about the road section, such as road grade.

"Section" is an explanatory characteristic.

Traffic.

Posted speed limit. This is an explanatory characteristic.

Average vehicle age. This is an explanatory characteristic.

Average daily traffic (ADT). This is an explanatory characteristic.

Method. The procedure used to measure ADT, such as a manual counter or automatic instrument. "Method" is a data-quality characteristic.

ADT duration. The time frame for which ADT was measured. "ADT duration" is a data-quality characteristic.

Uncertainty. The uncertainty of the ADT measurement as a function of method and duration is a data-quality characteristic.

Vehicles during storm. The number of vehicles that pass through the study section during the storm event being studied. "Vehicles during storm" is an explanatory characteristic.

Uncertainty. The uncertainty of the vehicles during storm measurement is a data-quality characteristic.

Acceleration or braking areas (ramps). Refers to the presence of any areas, in the drainage area, that include limited access highway ramps, traffic lights, and areas of substantial stop and go traffic where vehicles would accelerate or brake. "Acceleration or braking areas" is an explanatory characteristic.

Drainage system type. The structure, natural or manmade, that removes runoff from the drainage area, such as a swale, pipe, combined sewer, or storm drain. "Drainage system type" is an explanatory characteristic.

Maintenance and Right-of-way practices. The procedures used by highway personnel to clean and maintain the highway that can be verified by the reviewer from information included in the report. The reviewer should not assume that practices, such as deicing, (for instance) were used because the study was done in an area that receives a lot of snowfall. "Maintenance and Right-of-way practices" is an explanatory characteristic.

BMP used. Refers to the use of a best management practice to mitigate the effects of runoff on the local watershed. BMPs include structural methods, such as grassy swales and detention ponds, and management methods, such as street sweeping. "BMP used" is an explanatory characteristic.

Geographic characteristics (local). Details about the local topography or terrain at the study site. Some examples might include local elevation or if the study area is located in a rain shadow. "Geographic characteristics" is an explanatory characteristic.

Local area soil attributes. Attributes of the local soil, such as soil type, cation exchange rate, and permeability. "Local area soil attributes" is an explanatory characteristic.

Local vegetation. The type and (or) condition of the vegetation at the study site. An example might be whether the vegetation is grass or trees and whether it is natural or landscaped. "Local vegetation" is an explanatory characteristic.

Precipitation.

Volume total and snow. The total volume of rain and (or) snow in the study area, usually presented as an annualized amount.

Number storms/year. The number of storm events in a specific calendar year.

Intensity. The amount of precipitation that falls in a unit time interval (Nevada Division of Water Planning, 1997). Rain intensity can be measured or calculated instantaneously, as a function of time, or as a function of the total storm volume and duration. For example, a short storm with a given volume of rainfall has a higher total storm intensity than a long storm with the same amount of rainfall even though intensities during the longer storm may exceed the peak intensity of the shorter storm.

Duration. The period of time during which rain or snowfall occurs in a storm event.

Mean monthly event. The average amount of precipitation per storm per month during the study period.

Mean monthly antecedent dry period. The average number of days without precipitation preceding a storm on a monthly basis during the study period.

“Precipitation” is an explanatory characteristic.

Mean annual temperature. This is an explanatory characteristic.

Mean January temperature. This is an explanatory characteristic.

Average wind speed. This is an explanatory characteristic.

Other useful information. Provides a space for the reviewer to add additional information relevant to the particular study site, such as prevailing wind direction, highway mile-post number, and so on, that help identify the site location and characteristics where samples were collected.

5. WATER-QUALITY-MONITORING METHODS

Documentation of water-quality-monitoring methods is necessary to assess the comparability of the data and overall data quality and to identify explanatory characteristics. Monitoring methods documentation characterizes the monitoring and sample collection efforts facilitate water-quality data assessment. In addition to documentation, this section also addresses sample integrity issues that may arise during sampling. If the monitoring methods are described in detail in another referenced report, the reviewer should record and note the reference in this section.

Sampling program. Documents the reported sampling intervals of the study.

- *periodic*. Sampling occurs at repeated regular intervals, such as hourly, daily, weekly, monthly, and so on.
- *random.* Sampling occurs at irregular intervals, such as according to statistical sampling theory or when opportune.
- *storm event.* Sampling occurs at times determined by the occurrence of storm events, such as when precipitation, dustfall, or snowmelt is expected to occur at a predetermined minimum intensity and volume.
- *other*. Sampling occurs at times determined by different criteria than noted above, such as on holidays with high traffic volume.

"Sampling program" is a comparability characteristic and a data-quality characteristic.

Change in stage. Stage is the height of water above an established datum plane. Change in stage refers to the documented change in hydrograph (defined in glossary A – appendix 1) stage at the time of sampling.

- *rising.* Increasing flow or stage during sampling. The slope of the hydrograph is positive.
- *falling.* Decreasing flow or stage during sampling. The slope of the hydrograph is negative.
- *steady.* Unchanged flow or stage during sampling. The slope of the hydrograph is zero.
- *peak.* Maximum flow or stage for the hydrograph during sampling. The slope of the hydrograph is zero and the hydrograph is between rising and falling states.
- *base-flow*. Sustained flow or stage during periods of no storm events (Langbein and Iseri, 1960). Usually, the slope of the hydrograph is negative, but is approximately zero.
- *storm-hydrograph.* Sampling times occur at all stages of the hydrograph for a storm event. Sampling is carried out throughout the duration of the storm.
- *U (unknown).* Position and slope of the hydrograph is unknown at the times of sampling.

- *other.* Sampling is carried out without reference to the hydrograph but instead to another physicochemical feature, such as a measured change in a water-quality indicator variable.

"Change in stage" is an explanatory characteristic.

Continuous monitoring of water level. Indicates whether water level (stage) was measured and recorded throughout the sampling period. "Continuous monitoring of water level" is a data-quality characteristic.

Continuous monitoring of QW properties. Indicates whether water-quality (QW) properties were measured and recorded on a real-time basis during the sampling period. Water-quality properties refer to physicochemical measurements that indicate water quality. Some examples of QW properties include the choices shown in the following subcategory:

> **QW properties monitored continuously.** Indicates which water-quality properties were continuously monitored. Choices include *SPC* (specific conductance), *water temperature*, *air temperature*, *pH*, *DO* (dissolved oxygen), *redox* or *pe* (reduction-oxidation potential), and *turbidity*. In addition, there is space for the reviewer to note *other* properties.

"Continuous monitoring of QW properties" is a data-quality characteristic.

Sampling. Documents the sampling plan for water-quality properties and constituents. The reviewer can document sampling methods by choosing *manual* and (or) *automatic* (defined in glossary A – appendix 1). The reviewer also can comment on the sampling methods.

> **In time.** Refers to variations in time represented by the samples.
>
> - *discrete.* Defined in glossary B (appendix 1). For example, samples that are collected at individual points in time to characterize water quality at each respective time.
> - *composite.* Defined in glossary B (appendix 1). For example, samples that are collected at a number of points in time to characterize water quality to represent the entire volume of flow during the sampling interval.
>
> The reviewer can choose discrete and (or) composite, as appropriate, and also make a comment.

In space. Refers to variations in spatial locations where the samples are collected.

- *discrete*. Defined in glossary B (appendix 1). For example, samples that are collected at several points on a stream and analyzed separately.
- *composite*. Defined in glossary B (appendix 1). For example, samples that are collected at several points on a stream and combined before analysis.

The reviewer can choose *discrete* and (or) *composite*, as appropriate, and also make a comment.

Identification of samples as discrete or composite in time and space is a comparability characteristic.

Compositing method. Applies if a composite sample was collected in either time or space. The reviewer can characterize compositing methods by choosing *manual* and (or) *automatic*.

Compositing protocol. The method for determining the mixing ratios in the composite sample. Examples include flow weighted and time averaged.

Compositing method is a comparability characteristic and a data-quality characteristic.

First-flush samples. Refers to samples that are taken from the first runoff after the start of a storm. If first-flush samples were taken, the reviewer should indicate the interval(s) for the sampling. The reviewer also can make a comment. “First-flush samples” is an explanatory characteristic.

Sampling materials. Refers to the materials that physically contacted the samples during sample collection and handling. Typical materials include metal, plastic, polyethylene, and rubber. “Sampling materials” is a data-quality characteristic.

6. SAMPLE-HANDLING METHODS

Documented sample-handling methods are important to assess data quality and to meet established legal requirements. The sample-handling methods section characterizes methods for maintaining sample integrity from collection to analysis during the sampling process in a given study. This section helps to determine whether the data were collected and analyzed in a consistent manner that is well documented and accepted by the scientific community.

Chain-of-custody. A record of every person who had possession of the sample during collection and analysis. Chain-of-custody is required for any sample data to be admissible in court proceedings (Klodowski, 1996). The reviewer also can make a comment about the chain-of-custody procedures that were used. "Chain-of-custody" is a legal requirement.

Sample homogenized. Refers to whether the sample was mixed to create a uniform sample before analysis.

> **Methods.** Refers to the method that was used to homogenize the sample.

"Sample homogenized" is a data-quality characteristic.

Preservation. Defined in glossary A (appendix 1).

> **Methods.** Refers to the methods that were used for sample preservation, such as chemical processing, chilling, or freezing.
>
> **Materials.** Refers to the materials that were used for sample preservation, such as acid or ice.

"Preservation" is a data-quality characteristic.

Field shelf life before analysis. The documented length of time between sample collection and sample analysis in the field or shipment for analysis in the laboratory. "Field shelf life before analysis" is a data-quality characteristic.

Lab shelf life before analysis. The documented length of time the sample was stored in the laboratory before it was analyzed. "Lab shelf life before analysis" is a data-quality characteristic.

Field processing materials. Refers to materials that come into physical contact with the sample in the field after collection and before laboratory analysis. "Field processing materials" is a data-quality characteristic.

Lab processing materials. Refers to materials that come into physical contact with the sample during laboratory processing. “Lab processing materials” is a data-quality characteristic.

Name of laboratory used. The name of the laboratory that was used to analyze the samples. “Name of laboratory used” is a data-quality characteristic and a legal requirement.

> **Certified.** Indicates whether the laboratory participates in an external, comprehensive, documented QA/QC program. For example, the U.S. EPA has a laboratory certification program. “Certified” is a data-quality characteristic.

Standard field forms. Refers to the use of a standard field form used to record information to document conditions during sampling efforts. These forms are used to maintain consistency in sampling operations and for documenting sampling conditions and any factors that may affect the integrity of the samples collected. The reviewer can generally assume that studies by the USGS follow this protocol. The reviewer can make a comment, such as a note about any assumptions underlying the response. “Standard field forms” is a data-quality characteristic.

7.0 CONSTITUENT INFORMATION

Documented constituent information is necessary to identify constituents that were examined during a study and to assess related data quality and comparability issues. This section divides the constituents into 14 categories, which are operationally defined for this study (glossary A-appendix 1). Each category corresponds to an additional subsection with more detailed information in the review sheet. For instance, if an affirmative answer is given for Properties (which documents the properties that were measured), then subsection 7.01 must be filled out. The categories and corresponding subsection numbers are presented in table 1 of this appendix.

Table 1. Constituent categories and subsection numbers for constituent information, Section 7.0 of the National Data and Methodology Synthesis Data Review Sheet.

Subsection number	Category
7.01	Properties
7.02	Deicers
7.03	Major constituents
7.04	Nutrients
7.05	Metals and trace elements
7.06	Solids, sediment, and turbidity
7.07	Oxygen demand
7.08	Organics
7.09	Pesticides and herbicides
7.10	Microbiology
7.11	Eutrophication
7.12	Biological parameters
7.13	Toxicity testing
7.14	Other constituents

The division of constituents (defined in glossary A – appendix 1) into these categories was based on the classification of constituents commonly found in highway and urban runoff studies. Some of these subsections also document data-quality issues specific to a particular class of constituents (as appropriate). The data-quality questions listed in each subsection are issues of particular importance for interpreting data for that class of constituents. Although some of these questions may appear to duplicate questions found in other sections these questions directly pertain to constituent-specific protocols.

Throughout the review process, new constituents were added to the lists. If new constituents can be readily assigned to a category using published materials or expert input, the reviewer should assign them; if not, the reviewer should record them in subsection 7.14 (other constituents).

Subsection 7.01 through subsection 7.14 are not completed for review/summary reports because these types of reports do not provide the information needed to assess data quality for individual analytes. Also, information about the sampling matrix and detection limits is not typically described in these reports. However, section 7.0, indicating general categories, is completed for review/summary reports to indicate that the subject report is a potential source of information about analytes in a given category.

7.01 PROPERTIES

Calibration. Defined in glossary A (appendix 1). The reviewer also can make a comment. “Calibration” is a data-quality characteristic.

Temperature compensation. Refers to manual or automatic methods used to ensure that variations in air and water temperature do not introduce bias or decrease the accuracy and precision of the environmental instrumentation readings. The reviewer also can make a comment. “Temperature compensation” is a data-quality characteristic.

Periodic maintenance. Documents the actions taken on a regular basis to manually inspect, clean, calibrate, and, if necessary, replace the environmental instrumentation. The reviewer also can make a comment. “Periodic maintenance” is a data-quality characteristic.

Analytes. The reviewer should record whether analysis of each of the listed properties was documented. When applicable, the reviewer should indicate units, as well as the following:

> *Method*. The analytical method that was used to detect and quantify the property in question. “Method” is a data-quality characteristic.

7.02 DEICERS

Analytes. The reviewer should record whether analysis of each of the listed deicers was documented. When applicable, the reviewer should indicate the following:

> *Reported.* For each analyte, the reviewer should indicate the water matrix that was used as *total* and (or) *dissolved*. If the water matrix is unknown, the reviewer should circle *U (unknown)*. If a matrix other than water was used, the reviewer can record it as *other*. “Reported” is a comparability characteristic.

7.03 MAJOR CONSTITUENTS

Analytes. The reviewer should record whether analysis of each of the listed major constituents was documented. When applicable, the reviewer should indicate the following:

> *Reported.* For each analyte, the reviewer should indicate the water matrix that was used as *total* and (or) *dissolved*. If the water matrix is unknown, the reviewer should circle *U (unknown).* If a matrix other than water was used, the reviewer can record it as *other*. "Reported" is a comparability characteristic.

7.04 NUTRIENTS

Analytes. The reviewer should record whether analysis of each of the listed nutrients was documented. When applicable, the reviewer should indicate the following:

> *Reported.* For each analyte, the reviewer should indicate the water matrix that was used as *total* and (or) *dissolved*. If the water matrix is unknown, the reviewer should circle *U (unknown).* If a matrix other than water was used, the reviewer can record it as *other*. "Reported" is a comparability characteristic.

7.05 METALS AND TRACE ELEMENTS

Clean trace-element sampling protocols used. Refers to procedures that are designed to minimize bias (contamination and(or) attenuation of constituents in solution) caused by the sampling process. Clean protocols are characterized by use of carefully controlled materials and methods during the sample-collection and handling processes that have been shown to minimize bias for the metals and trace elements being analyzed. The reviewer can **describe** the protocols that were used in the space provided. "Clean trace-element sampling protocols used" is a data-quality characteristic.

Matrix. Several options are presented to indicate the sampling matrix for metals and (or) trace elements. The reviewer can choose from *suspended sediment*, *whole water*, *filtered water*, *sediment core*, and *other* (defined in glossary A – appendix 1). "Matrix" is a comparability characteristic.

> *Filter.* If the matrix is filtered water (dissolved) or suspended sediment (separated from the aqueous phase by filtration), the reviewer can indicate specific filter characteristics, such as ***filter type, pore size, material, and size (diameter).*** These are all data-quality characteristics and comparability characteristics.

Sampler material. Refers to materials that physically contacted samples during collection. Examples include metal, plastics, teflon, and glass. "Sampler material" is a data-quality characteristic.

Processing material. Refers to the materials that physically contacted the samples during field and laboratoryprocessing. "Processing material" is a data-quality characteristic.

Preservation. Refers to the process used to minimize undesirable chemical reactions in the sample container between sample collection and analysis. "Preservation" is a data-quality characteristic.

Analytes. The reviewer should record whether analysis for each of the listed metals or trace elements was documented. When applicable, the reviewer should indicate the following:

> *Reported.* For each analyte, the reviewer should indicate the water matrix that was used as *total* and (or) *dissolved*. If the water matrix is unknown, the reviewer should circle *U (unknown).* If a matrix other than water was used, the reviewer can record it as *other*. "Reported" is a comparability characteristic.
>
> *Detection limits.* Defined in glossary A (appendix 1). "Detection limits" is a data-quality characteristic and a comparability characteristic.

7.06 SOLIDS, SEDIMENT, AND TURBIDITY

Sampling. Refers to the method that was used for sampling solids in fluids, such as water and air. The reviewer can choose *manual* and (or) *automatic* (defined in glossary A – appendix 1) and comment if necessary. "Sampling" is a data-quality characteristic.

> **Isokinetic**. Refers to sampling that occurs when the fluid in the sampling nozzle moves at the same velocity as the effluent stream, which is important to ensure that the particle-size distribution in the sample represents the particle-size distribution in thewater being sampled (Winegar and Edwards, 1996). The reviewer also can make a comment. "Isokinetic" is a data-quality characteristic.
>
>> **If automatic or grab, calibrated to isokinetic.** Refers to the comparison of automatic or grab sampling data to isokinetic sampling data. Calibration of automatic and (or) grab data to isokinetic data includes adjustment for systematic errors. "If automatic or grab, calibrated to isokinetic" is a comparability characteristic and a data-quality characteristic.
>
> **Space.** Refers to how the samples represent variations in space. The reviewer can choose *discrete* and (or) *composite* (defined in glossary B – appendix 1) and make a comment.

Time. Refers to how the samples represent variations in time. The reviewer can choose *discrete* and (or) *composite* (defined in glossary B – appendix 1) and make a comment.

Identification of samples as discrete and (or) composite in time and space is a comparability characteristic.

Sampler type. The brand and (or) model of the equipment that was used to sample for solids in fluids. "Sampler type" is a comparability characteristic and a data-quality characteristic.

Nozzle sizes. Refers to the diameter of the nozzle that was used to direct the fluid into the sampling container. "Nozzle sizes" is a comparability characteristic.

Transit rate. The amount of time it takes to sample a cross section of the flow. "Transit rate" is a data-quality characteristic.

Depth (stage). Indicates that the depth of water at the sampling section was measured during the sampling event "Depth (stage)" is an explanatory characteristic.

Flow rate. Indicates that the discharge of water was measured at the sampling section during the sampling event, and indicates the method used for determining flow.

- *measured.* The flow rate was derived from measurements taken during water-quality sample collection.
- *from rating.* The flow rate was estimated from a rating curve.
- *other.* The flow rate was determined by a method different from those above. This also applies to unknown methods.

"Flow rate" is an explanatory characteristic.

Sampled whole hydrograph. Applies if samples were collected during the entire runoff or storm event. The reviewer also can make a comment. "Sampled whole hydrograph" is an explanatory characteristic.

Methods. Refers to methods that were used for collection of solids. "Methods" is a data-quality characteristic.

Standard field forms. Refers to the use of a standard field form used to record information to document conditions during sampling efforts. These forms are used to maintain consistency in sampling operations and for documenting sampling conditions and any factors that may affect the integrity of the samples collected. "Standard field forms" is a data-quality characteristic.

Name of sediment laboratory used. This is a data-quality characteristic.

> **Certified.** Refers to whether the laboratory participates in an external, documented, and comprehensive QA/QC program. For example, the USEPA has a laboratorycertification program. “Certified” is a data-quality characteristic.

Depths at which samples taken. This is a comparability characteristic.

Duplicates. A QA/QC procedure where two samples are taken at the same time and place and the analytical results are compared. The reviewer also can make a comment. “Duplicates” is a data-quality characteristic.

Calibrate sampling personnel. Refers to the comparison of data obtained by different sampling personnel. Calibration includes the adjustment of the data to account for systematic errors. The reviewer also can make a comment. “Calibrate sampling personnel” is a data-quality characteristic.

Turbidity. Defined in glossary A (appendix 1). The reviewer should indicate whether turbidity measurement was *manual* or *automatic*.

> *Maintenance/cleaning interval*. The maintenance schedule for the turbidimeter (turbidity measurement equipment) or the time interval between cleanings of the turbidimeter. “Maintenance/cleaning interval” is a data-quality characteristic.

> *Calibration***.** Indicates the turbidy calibration standards (defined in glossary A – appendix 1). “Calibration” is a comparability characteristic.

Analytes. The reviewer should record whether analysis for each of the listed aqueous constituents and solid constituents was documented. Where applicable, the reviewer should indicate **units**, as well as the following:

> *Method.* The analytical method that was used to test the analytes in question. “Method” is a data-quality characteristic.

Suspended-matter size distribution information. Information on the quantities of suspended matter at different sizes. The reviewer should indicate whether analysis for this parameter was documented.

> **Specification**. The matrix used to determine size distribution information.
>
> - *dissolved.* Defined in glossary A (appendix 1).
> - *colloidal.* Defined in glossary A (appendix 1).
> - *suspended.* Defined in glossary A (appendix 1).
> - *settleable.* Bits of debris, sediment, or other solids that are heavy enough to sink when a liquid is allowed to stand in a pond or tank (Nevada Division of Water Planning, 1997).

How reported. The format of the size distribution information, such as graphic or table (defined in glossary B – appendix 1). "How reported" is an accessibility characteristic.

"Specification" is a comparability characteristic.

Sediment. Indicates to whether nonaqueous phase sediment samples were collected. The reviewer should indicate the matrix for the sediment.

- *bottom/bed materials.* Defined in glossary A (appendix 1).
- *soil.* Defined in glossary A (appendix 1).
- *sweepings.* The sediment that accumulates on the road surface and is removed as a result of road maintenance practices.
- *dust.* Fine, dry, pulverized particles, often a result of atmospheric deposition (Nevada Division of Water Planning, 1997).
- *dredge.* Sediment collected as a result of dredging; a method for deepening streams, swamps, or other waters by scraping and removing solid materials from the bottom (Nevada Division of Water Planning, 1997).

"Sediment" is a comparability characteristic.

Analytes. The reviewer should record whether analysis for each of the three listed properties–**grain size**, **chemical** and (or) **age dating–**was documented. The reviewer can comment on any of these tests as well as record the following:

How collected. Refers to the collection methods for sediment.

Other. The reviewer can note other methods for monitoring solids or sediment that are not in the review sheets.

7.07 OXYGEN DEMAND

Analytes. The reviewer should record whether analysis for each of the listed types of oxygen demand was documented.

7.08 ORGANICS

Sampler type. The type of sampler that was used to collect organics samples, such as a plastic bucket or an automatic sampler. "Sampler type" is a comparability and a data-quality characteristic.

Materials (sampling). Refers to materials that physically contacted samples during collection. Examples include metal, plastics, teflon, and glass. "Sampler material" is a data-quality characteristic.

Manual or auto. Characterizes the sampling method used for organics. The reviewer can characterize sampling methods by choosing manual and (or) automatic. “Manual or auto” is a data-quality characteristic.

Discrete or composite. Characterizes whether the organic samples were collected as discrete and (or) composite samples (defined in glossary A – appendix 1) in time and (or) space. “Discrete or composite” is a data-quality characteristic.

Where in the flow. The position of the sampler intake with respect to the cross-section and profile of water flow. Examples include pipe outlet and the middle of a stream. “Where in the flow” is a comparability characteristic.

Precleaned sampler. Refers to whether the sampler was cleaned prior to each sampling round. Common cleaning methods include washing the sampler with distilled water between sampling rounds. The reviewer also can make a comment on the methods that were used for cleaning. “Precleaned sampler” is a data-quality characteristic.

Container material. Refers to the material of the container in which the sample was transported or stored during field and (or) laboratoryprocessing. “Container material” is a data-quality characteristic.

Sample location volatilization. Refers to whether a sample was taken at a location where volatilization (off-gassing as vapor) occurred before sampling. Volatilization can occur when water falls, such as from a pipe outfall. “Sample location volatilization” is a data-quality characteristic.

Sampler volatilization. Refers to whether the sampler uses suction during sample collection and, thus, induces volatilization. “Sampler volatilization” is a data-quality characteristic.

Analytes. The reviewer should record whether analysis for each of the listed organics was documented. When applicable, the reviewer should indicate the following:

> *Reported.* For each analyte, the reviewer should indicate the water matrix that was used as *total* and (or) *dissolved*. If the water matrix is unknown, the reviewer should circle *U (unknown)*. If a matrix other than water was used, the reviewer can record it as *other*. “Reported” is a comparability characteristic.
>
> *Detection limits.* Defined in glossary A (appendix 1). “Detection limits” is a data-quality characteristic and a comparability characteristic.

At the bottom of the first page of the organic section there is a list of five subcategories of organics. Each organic is listed under one of the following subcategories**: Semivolatile Organic Compounds (SVOC)**, **Polyaromatic Hydrocarbons (PAH – a class of SVOC)**, **Volatile Organic Compounds (VOC)**, **Fuel-related VOCs (BTEX and oxygenates)**, and **Other Organic Compounds**. Any organic compound that is found in a report and is not listed can be reported in “Other Organic Compounds” on the last page of this subsection.

7.09 PESTICIDES AND HERBICIDES

Seasons sampled. Refers to the seasons of the year in which pesticide sampling occurred. “Seasons sampled” is a comparability characteristic and an explanatory characteristic.

Sampling frequency. Refers to how often pesticide sampling took place. “Sampling frequency” is a data-quality characteristic.

If highway, site-maintenance schedule. Refers to whether the site maintenance schedule for a highway site is given in the report. “If highway, site maintenance schedule” is an explanatory characteristic.

Sampling after application. Refers to whether samples were collected from an area during the first few storms after pesticides were applied. “Sampling after application” is an explanatory characteristic.

Methods. Refers to the sampling methods that were used to collect pesticide samples. “Methods” is a data-quality characteristic.

Materials (sampling). Refers to materials that physically contacted samples during collection. Examples include metal, plastics, teflon, and glass. “Materials” is a data-quality characteristic.

Matrix used. The medium in which the pesticide was tested. Some examples of commonly tested matrixes are whole water, filtered water, suspended sediment, and sediment core (defined in glossary A – appendix 1). “Matrix used” is a comparability characteristic.

Analytes. The reviewer should record whether analysis for each of the listed pesticides was documented. When applicable, the reviewer should indicate the following:

> *Reported.* For each analyte, the reviewer should indicate the water matrix that was used as *total* and (or) *dissolved*. . If the water matrix is unknown, the reviewer should circle *U (unknown)*. If a matrix other than water was used, the reviewer can record it as *other*. “Reported” is a comparability characteristic.

Detection limits. Defined in glossary A (appendix 1). “Detection limits” is a data-quality characteristic and comparability characteristic.

At the bottom of the first page of the pesticide and herbicide section is a list of four subcategories of pesticides. Each pesticide is listed under one of the following subcategories: **Insecticides**, **Herbicides**, **Fungicides**, and **Transformation products**. Any pesticide that is in a report and is not listed can be reported in the last page of this subsection entitled "other pesticides and herbicides".

7.10 MICROBIOLOGY

Equipment sterilization methods. Refers to the methods that rid equipment of living microorganisms prior to sampling. This includes general cleaning and removal of contaminants and sterilization with chemicals or heat. “Equipment sterilization methods” is a data-quality characteristic.

Sterile technique. Refers to methods employed during sample collection, handling, and processing that prevent samples from being contaminated by living organisms not originally in the sampling matrix. “Sterile technique” is a data-quality characteristic.

Collection method. Refers to how the samples represent variations in space.

- *grab.* Discrete (defined in glossary B – appendix 1) in space.
- *depth/width integrated.* Composite (defined in glossary B – appendix 1) in space.
- *other.* Any collection method not listed above.

“Collection method” is a comparability characteristic.

Sample preservation and storage. Refers to techniques that maintain the integrity of the sample between collection and analysis. “Sample preservation and storage” is a data-quality characteristic.

Holding times. The length of time between collection and analysis of the samples. “Holding times” is a data-quality characteristic.

Analytes. The reviewer should record whether analysis for each of the listed microbiological constituents was documented. Three blocks labeled "other" are provided to list tests for microorganisms that are not listed on the sheet. When applicable, the reviewer should indicate units, as well as the following:

Culture media. The nutrient matrix for the cultivation of organisms for the purpose of population counts. “Culture media” is a data-quality characteristic.

7.11 EUTROPHICATION

Analytes. The reviewer should record whether analysis for each of the listed eutrophication indicators was documented. For each tested indicator, the reviewer also can make a comment.

Water balance. An accounting of the inflows, outflows, and storage changes for the water body being examined for eutrophication. The reviewer should indicate the sources of inputs to and outputs from the water body. "Water balance" is an explanatory characteristic.

Maximum depth. The maximum depth of the water body from the reference surface elevation. "Maximum depth" is an explanatory characteristic.

Mean depth. The average depth of the water body from the reference surface elevation. "Mean depth" is an explanatory characteristic.

Basin characteristics. Refers to the characteristics of the drainage basin for a specific water body. Examples include land use, topography, and climate. "Basin characteristics" is an explanatory characteristic.

Profiles. Refers to a water-quality characterization of a water body as a function of depth. If the study for eutrophication includes vertical profiles, the reviewer can indicate the type of profile. Some examples include temperature and dissolved oxygen profiles. "Profiles" and "type" are explanatory characteristics.

Other. The reviewer can note any additional eutrophication properties or measurements in this space.

7.12 BIOLOGICAL PARAMETERS

Sample site characteristics. Defines the geographic location and describes environmental variables that may affect the biological assessment. The reviewer should detail geographic information in the first space given. For each of the following categories of characteristics, the reviewer should choose all of the terms that apply.

> **Water-management features.** Generally refers to human made structures or facilities to control or use water. *Natural lake* is an exception to this definition.
>
> **Stream type.** Describes the characteristics of the stream segment studied, such as stream size, sinuosity, and gradient.
>
> **Geomorphic channel unit.** Fluvial geomorphic descriptors of channel shape and stream velocity (Fitzpatrick and others, 1998).
>
> **Bed substrate.** The layer of material beneath the soil surface at the bottom of the body of water.
>
> **Available light features.** Refers to shelter from sunlight.
>
> **Habitat features.** Describes the native environment or specific surroundings that support aquatic life.
>
> **Geomorphic features.** Refers to the local geology and topography that influence aquatic life.
>
> **Diagrammatic mapping.** A map showing locations of site characteristics listed in this section. The reviewer also can comment on the maps used.
>
> **Aquatic and riparian vegetation species.** Refers to the existence of vegetation in, on, or along bodies of water.

"Sample site characteristics" is a comparability characteristic and an explanatory characteristic.

Biotic Community Assessment. The determination of what organisms exist at a sampling site. If this analysis was done, the reviewer should note the **species** found, as well as the **collection method** and **collection device.** "Collection method" and "Collection device" are comparability characteristics and data-quality characteristics.

Biological fluid and tissue analysis. Refers to testing of fluids or tissue from an organism for specific analytes. If this analysis was done, the reviewer should note the **collection method** and **collection device**. **"**Collection method" and "Collection device" are data-quality characteristics.

> **What biota sampled.** The biological matrix (species) used in the test. "What biota sampled" is a comparability characteristic.

If biological fluid and tissue analysis was done, the reviewer should record the **Analytes** tested.

Methods. The reviewer should record whether analysis for each of the listed biological assessment methods were documented.

7.13 TOXICITY TESTING

Toxicity test lab. Indicates whether a laboratory toxicity test or bioassay was documented. The reviewer should record the species that were tested in the laboratory.

> **Water.** The type of water used in the laboratory toxicity test. The reviewer can choose from *lab, natural,* and *other*. "Water" is a data-quality characteristic.
>
> **Conditions.** Refers to conditions, such as lighting and temperature, in the laboratory at the time of the test. "Conditions" is a comparability characteristic and an explanatory characteristic.
>
> **Method.** The analytical method that was used during the laboratory toxicity test. "Method" is a data-quality characteristic.

Toxicity test field. Indicates whether a field toxicity test or bioassay was documented. The reviewer should record the species that were tested in the field.

> **Water.** The type of water that was used in the field toxicity test. The reviewer can choose from *lab, natural,* and *other.* "Water" is a data-quality characteristic.
>
> **Conditions.** Refers to conditions, such as lighting and temperature, in the field at the time of the test. "Conditions" is a comparability characteristic and an explanatory characteristic.
>
> **Method.** The analytical method that was used during the field toxicity test. "Method" is a data-quality characteristic.

Methods. The reviewer should record whether analysis for each of the listed toxicity-testing methods were documented.

7.14 OTHER CONSTITUENTS

Throughout the review process, new constituents were identified. These constituents were recorded in this "other constituents" subsection. When a new constituent was included as an analyte in more than one of the reports that were reviewed, efforts were made to classify the constituent. In many cases these constituents could readily be assigned to a category. In some cases, however, the constituent category was not obvious or the constituent did not fall into a category and so these constituents remain in this "other constituents" subsection.

8. SAMPLING FOCUS AND MATRIX

Documented sampling focus and matrix are important to assess data comparability. To be comparable, samples must be collected and analyzed from the same matrixes at sampling locations that are representative of the sampling focus.

Physical focus. The physical emphasis of the sampling program. The reviewer should record one or more sampling locations from the choices listed below.

Highway/road. Choices for specific locations relative to the highway or road include *pavement edge(gutter), catchbasin/gullypot*, *shoulders/median*, *drainage pipe*, and *other*. The reviewer also can make a comment providing more details.

BMP. Defined in glossary A (appendix 1). The reviewer should indicate the type of BMP. Choices for specific locations within the BMP include *inlet*, *forebay, center, outlet,* and *other*.

Combined sewer. A drainage network that carries both sanitary sewage and stormwater runoff.

Storm drain. A drainage network that carries only stormwater runoff, street wash, and snowmelt from the contributing area. Choices for specific storm drain locations include *in pipe*, *at lip*, and *spillway*. The reviewer also can make a comment providing more details.

Stream/river. A natural or engineered channel containing water from base flow (a ground-water contribution) for at least part of the year.

- *upstream.* The direction opposite from streamflow relative to the contaminant-source discharge point.
- *at discharge.* Where contaminant-source effluent joins the river or stream.
- *downstream.* The direction of streamflow from the contaminant-source discharge point.

The reviewer also can make a comment that provides more details.

Wetland. Transitional land, between terrestrial and aquatic systems, that is usually inundated or saturated by water. Wetlands include swamps, marshes, and bogs.

Lake/pond (not BMP pond). A body of inland water that is not engineered specifically to be a best management practice. Usually, but not necessarily, denoting a natural water body.

Coastal water. Ocean water that is adjacent to the coast.

Unknown. This refers to an unknown sampling location.

“Physical focus” is an explanatory characteristic.

Hydraulic focus. The hydrologic emphasis of the sampling program, the part of the hydrologic cycle being sampled (for example, precipitation, surface water, or ground water). The reviewer should record one or more sampling locations from the choices listed below.

Surface water. Defined in glossary A (appendix 1).

Unsaturated zone (also vadose zone or zone of aeration). The subsurface zone between the water table and the land surface where pore spaces in soil contain a mixture of water, air, and other gases at less than atmospheric pressure. The reviewer can specify the sampling location in the unsaturated zone with one or more of the following terms:

- *upgradient.* The direction opposite from unsaturated ground-water flow from the contaminant-source discharge point.
- *at discharge.* Where the contaminant-source effluent enters the unsaturated zone.
- *downgradient.* The direction of unsaturated ground-water flow from the contaminant-source discharge point.

The reviewer also can provide a comment about the unsaturated zone.

Ground water. Defined in glossary A (appendix 1) and refers to water flow in the saturated zone.

- *upgradient.* The direction opposite from saturated ground-water flow from the contaminant-source discharge point.
- *at discharge.* Where contaminant-source effluent enters the saturated zone.
- *downgradient.* The direction of saturated ground-water flow from the contaminant-source discharge point.

The reviewer also can provide a comment about the saturated zone.

Atmospheric deposition. Defined in glossary A (appendix 1). Specific types of atmospheric deposition include *wet, dry, rain, snow, air, dust, aerosols*, and *other*.

“Hydrologic focus” is a comparability characteristic.

Matrix. The medium from which samples are collected for analysis of physicochemical constituents or properties. The reviewer should record all sampling matrixes that apply from the categories below. The reviewer also should note the applicable analytical methods for each matrix.

Biota. Defined in glossary A (appendix 1). The reviewer also should note the specific biota matrix (species) sampled in *What sampled*.

Water. Different choices for the analysis methods for a water matrix include (defined in glossary A – appendix 1) *whole water, suspended solids, dissolved (filtered), colloids, filter residue,* and *unknown* analysis of a water matrix.

If filtered water. The reviewer should describe the filter used for the analysis of dissolved constituents in water by using the following categories: *pore size, filter type, brand, diameter/size* (of the entire filter), and *material.*

Sediment . (soil, street sweepings, dust, and other sediments)

- *total-total.* Sediment that was digested in its entirety for chemical analysis.
- *sand fraction.* Particles collected from aqueous sediment samples that are larger than silt and clay in diameter but smaller than gravel.
- *silt/clay*. Particles collected from aqueous sediment samples that are smaller than 63 microns in diameter.
- *bed-load.* Particles in movement along the bottom of a channel, in contrast with particles carried in suspension or solution.
- *sediment cores*. Material collected from soil or at the bottom of a waterway as a contiguous core for chemical or physical analysis.
- *bottom/bed material.* Defined in glossary A (appendix 1).
- *soil.* Defined in glossary A (appendix 1).
- *sediment.* Defined in glossary A (appendix 1).
- *sweepings.* Sediment that accumulates on the road surface and is removed as a result of road maintenance or sample collection.
- *dust.* Fine, dry, pulverized particles, often a result of atmospheric deposition (Nevada Division of Water Planning, 1997).
- *dredge.* Sediment collected as a result of dredging; a method for deepening streams, swamps, or other waters by scraping and removing solid materials from the bottom (Nevada Division of Water Planning, 1997).
- *unknown.* Refers to undocumented collection matrixes of sediment.
- *other*. Refers to sediment samples that do not readily fit into these categories.

Air or gas emissions. A matrix that is in gaseous form.

Other matrix. A matrix other than those listed above.

"Matrix" is a comparability characteristic**.**

9. FLOW-MONITORING METHODS

Documenting flow-monitoring methods is necessary to assess the data quality of water-quality measurements, event mean concentration calculations, estimated loads, and the applicability of flow data for use as explanatory variables. This section is divided into categories for surface water, ground water, precipitation, and other flow data because different metadata characteristics are of concern for each of these flow types. The reviewer should complete this section only if flow was monitored during the study, as indicated by an affirmative response to the flow question in section 2.

Where measured in relation to QW samples. Describes the location for monitoring the flow of water relative to the location for water-quality sampling. For example, possible responses may be, "flow monitored upstream of QW sample uptake," or "on the opposite bank from QW sampling." "Where measured in relation to QW samples" is a data-quality characteristic.

Where. Describes the flow regime that was monitored. The report may quantify the following types of flow. The reviewer should indicate all locations sampled.

- *deposition.* Operationally defined here as any form of precipitation.
- *evaporation.* The physical process by which a liquid (or a solid) is transformed into a gaseous state (Nevada Division of Water Planning, 1997).
- *sheet-flow.* Movement of water in a thin, continuous film (Nevada Division of Water Planning, 1997).
- *surface-water.* Defined in glossary A (appendix 1).
- *unsaturated-zone.* The subsurface zone between the water table and the land surface where pore spaces in soil contain a mixture of water, air, and other gases at less than atmospheric pressure. Also referred to as the vadose zone or zone of aeration (Nevada Division of Water Planning, 1997).
- *ground water.* Defined in glossary A (appendix 1).
- *other.* Any types of flow not listed.

"Where" is a comparability characteristic.

Surface water.

Flow. Refers to how the flow rate of surface water was determined.

- *measured.* Applies if the flow was measured or calculated (defined in glossary B – appendix 1) by using measurements taken during sample collection.
- *estimated.* Applies if the flow was estimated from flow measured at a nearby site, from a rainfall/runoff estimate (such as the rational formula) or any methods using drainage basin characteristics to estimate flows.

Channel type. Identifies the natural or engineered water conduits.

- *river.* A natural body of flowing water of considerable volume, larger than a brook or a creek.
- *stream.* A natural body of flowing water smaller than a river, such as a brook or a creek.
- *pipe.* An enclosed conduit with either open-channel flow or with no pressure flow.
- *swale.* A slight depression designed to convey flow in a grassy channel Swales usually carry water flows only during or immediately after runoff events.
- *human-made channel.* An excavated or lined watercourse, such as a drainage ditch or canal.
- *sheet-flow pavement.* Movement of water in the form of a thin, continuous film (Nevada Division of Water Planning, 1997) over pavement.
- *sheet-flow soil.* Movement of water in the form of a thin, continuous film (Nevada Division of Water Planning, 1997) over soil.
- *sheet-flow vegetation.* Movement of water in the form of a thin, continuous film (Nevada Division of Water Planning, 1997) over vegetation.
- *overland-flow pavement.* The dendritic flow of rainwater or snowmelt over a paved surface toward drainage or stream channels (Nevada Division of Water Planning, 1997).
- *overland-flow soil.* The dendritic flow of rainwater or snowmelt over soil toward drainage or stream channels (Nevada Division of Water Planning, 1997).
- *overland-flow vegetation.* The dendritic flow of rainwater or snowmelt over vegetation toward drainage or stream channels (Nevada Division of Water Planning, 1997).
- *other.* The report gives a surface-water channel type not listed above.

Stage. The measurement of the depth of flow relative to a specific datum.

Type. The type of equipment that was used to measure stage.

Resolution. The maximum precision associated with the equipment.

Discharge. The measurement of the volume of water passing a specified point for a specific period of time.

Type. The type of equipment that was used to measure discharge.

Resolution. The maximum precision associated with the equipment.

Velocity. The measurement of speed (linear rate of movement) and direction of the flowing water. Often, direction is omitted.

Type. The type of equipment that was used to measure velocity.

Resolution. The maximum precision associated with the equipment.

Hydraulic controls. The physical characteristics of a channel, such as a natural constriction, a long straight reach, a stretch of rapids, or an engineered structure downstream from a gaging station, that determine a unique stage-discharge relation at the gage. "Hydraulic controls" is a data-quality characteristic.

Type. The type of hydraulic control. Choices include *weir* or *flume***.** "Type" is a data-quality characteristic.

Maintained/cleaned. Refers to regular maintenance and cleaning of the hydraulic control that was used to determine flow. "Maintained/cleaned" is a data-quality characteristic.

.

Rating. This is the stage-discharge relation for the channel or water body, typically expressed in graphic or tabular format.

- *measured.* An empirical relation that is based on previous or current stage and discharge measurements for the water body.
- *estimated.* A relation that is extrapolated from limited stage and discharge information or a measured rating at a nearby site.
- *theoretical.* A relation that is based on either theoretical or empirical equations.

Rating verified independently. Refers to checking the rating relation with stage and discharge data from an independent measurement method for the channel.

"Rating" is a data-quality characteristic.

Personnel trained and experienced. This is a data-quality characteristic and a legal requirement.

Uncertainty of flow calculation. The propagation of measurement errors in the reported flow result. "Uncertainty of flow calculation" is a data-quality characteristic.

Flow (flux) measured. Refers to flow measurements that are independent of a stage-discharge relation. Equipment for this type of monitoring could be an independent velocity meter or an independent flow meter. Examples include Doppler velocity meters and electromagnetic flow meters. "Flow (flux) measured” is a data-quality characteristic.

Frequency of stage measurements. Refers to how often stage (the water level) was measured. “Frequency of stage measurements” is a data-quality characteristic.

Automated monitoring. Refers to the continuous automatic monitoring of flow. “Automated monitoring” is a data-quality characteristic.

System type instruments. Refers to the brand or model of the instruments, as well as any additional information about the flow-monitoring equipment. “System type instruments” is a data-quality characteristic.

Appropriate calibrated functioning-in-design ranges. Refers to the suitability of the equipment's measurement range relative to actual flow values. Also indicates if the equipment has been calibrated within the expected range of flow. For example, if the equipment is designed to measure flows over 1 ft^3/s and most flows in the channel of interest are below 1 ft^3/s, the equipment is inappropriate. “Appropriate calibrated functioning-in-design ranges” is a data-quality characteristic.

Ground Water.

Geologic materials. Characterizes the unconsolidated materials in the saturated zone of the aquifer. The reviewer should choose all that apply.

- *bedrock.* The solid rock that lies beneath soil, loose sediments, or other unconsolidated material (Nevada Division of Water Planning, 1997).
- *karst.* Areas of limestone and dolomite with a topography peculiar to and dependent on underground solution and the diversion of surface waters to underground routes (Nevada Division of Water Planning, 1997).
- *till.* The mixture of rocks, boulders, and soil picked up by a moving glacier, transported, and deposited along the path of the ice advance (Nevada Division of Water Planning, 1997).
- *sand -and-gravel.* Predominantly coarse-grained mineral sediments and rock fragments with diameters larger than 0.074 mm (0.0029 in.) and smaller than 7.6 cm (3 in.) in diameter (Nevada Division of Water Planning, 1997).
- *other.* Geologic material not listed above.

“Geologic materials” is an explanatory characteristic.

Confined vs. unconfined. Characterizes the type of aquifer. A confined aquifer is overlain by formations of impermeable or relatively impermeable material and the pressure at the aquifer’s upper limit can be higher than atmospheric pressure.

An unconfined aquifer is at atmospheric pressure at its upper limit–the water table. “Confined vs. unconfined” is an explanatory characteristic.

Hydraulic conductivity. Refers to the method used to quantify the coefficient of proportionality that describes the rate at which water moves through an aquifer or other permeable medium (Nevada Division of Water Planning, 1997).

- *slug-test.* Inducing a small instantaneous change of water volume into a well while measuring the hydraulic head response.
- *area-pump-test.* Pumping a well for a period of time and observing the change in hydraulic head in the well and other observation wells in the aquifer (Fetter, 1988).
- *localized-pump-test.* Pumping a well for a period of time and observing the change in hydraulic head in the well (Fetter, 1988).
- *grain-size-analysis.* Estimates that are based on the distribution of sediment sizes in soil samples from the aquifer.
- *permeameter.* A method that measures the rate of water movement through a sample column by using sediment samples from the aquifer.
- *other.* A hydraulic conductivity method or test not listed above.

“Hydraulic conductivity” is a data-quality characteristic. The type of hydraulic conductivity is a comparability characteristic.

Continuous water-level recorder. Indicates whether a device was used to record ground-water levels at least once per day. This is a data-quality characteristic.

Method. Describes the type of continuous water-level recording equipment used in the study. Choices include *steel tape/chalk* and *electric beeper*. “Method” is a data-quality characteristic.

Water-level accuracy. The numerical estimate related to error in ground-water-level measurements. “Water-level accuracy” is a data-quality characteristic.

Precipitation.

What monitored. The type of precipitation measured, such as *rain, snow,* or *ice*. “What monitored” is an explanatory characteristic.

Data source. The source for precipitation data used in a study.

- *existing-network.* An independent, established, data-collection network such as the national network maintained by the National Oceanic and Atmospheric Administration (NOAA).
- *study-network.* Data collection sites in a network within the monitoring area designed to measure precipitation.
- *study-site.* One data-collection station at the study site to measure precipitation.

“Data source” is a comparability characteristic and a data-quality characteristic.

Distance from QW sites to precipitation sites. The approximate distance between water-quality-monitoring sites and precipitation monitoring sites.

- *<1,000 ft.* Less than or about 1,000 feet.
- *<1 mi.* Less than or equal to 1 mile, but greater than 1,000 feet.
- *<10 mi.* Less than or equal to 10 miles, but greater than 1 mile.
- *>10 mi.* Greater than 10 miles.

“Distance from QW sites to precipitation sites” is a data-quality characteristic.

Measured. Characterizes the form in which precipitation data was collected.

- *totals.* Sum of rainfall volume or depth for a specified time period.
- *intensity.* Rainfall rates per specified time increments.

“Measured” is a comparability characteristic.

Interval. Refers to the approximate time interval between precipitation measurements, such as *sec*ond, *min*ute, *hour*, or *day*. “Interval” is a data-quality characteristic.

How measured. Refers to whether precipitation measurements were *automatic*, *manual*, or *both* (defined in glossary A – appendix 1). “How measured” is a data-quality characteristic.

Gage heated. This is a data-quality characteristic.

If gage heated. The method used for heating the gage. “If gage heated” is a data-quality characteristic.

Method. Space for other notes related to the method of measuring precipitation. “Method” is a data-quality characteristic.

Other flow-related data. Space for other information pertinent to flow measurements for surface water, ground water, or precipitation or for information on methods for determining other types of flow. Possible other flows include evaporation and deposition. “Other flow-related data” is an explanatory characteristic.

10. QA/QC FIELD

Quality-assurance and quality-control (QA/QC) documentation is necessary to assess a data set in terms of data quality, comparability, and legal requirements. QA/QC programs detect and control errors as well as maintain and document the reliability and uncertainty of the data. Requirements for QA/QC programs have increased in the last two decades and now address all aspects of data collection. A properly designed QA/QC program will provide information to evaluate program design, sample collection, sample transport, sample storage, chain-of-custody control, sample analysis, documentation, and data reporting. All aspects of QA/QC are data-quality characteristics and can be legal requirements as well. This section addresses the practices reported for QA/QC in the field. The reviewer should fill out this section only if QA/QC information was given in the report, as indicated by an affirmative response to the QA/QC question in section 2.

Trained professional sampling team. This is a data-quality characteristic and a legal requirement.

Field sampling and processing QA/QC plan. The written plan that details use of QA/QC protocols for the field study. The objectives of the study define the data quality objectives that provide the basis for the plan.

> *Published.* The reference for the QA/QC plan. "Published" is an accessibility characteristic.
>
> > *Reference.* This is the reference for the QA/QC plan (if published). "Reference" is an accessibility characteristic.

For each of the following QA/QC procedures, the reviewer can respond with the following choices.

> *Y (yes).* The procedure is mentioned in the report.
> *N (no).* The procedure is not mentioned in the report.
> *U (unknown).* The procedure is part of the published plan for QA/QC, but is not mentioned in the report directly.

Intraoffice or independent QA/QC audit/review. The systematic examination of site selection, project documentation, procedures and records for calibration and maintenance of instrumentation and equipment, sample-collection handling and preservation methods, and availability of properly trained personnel by reviewers outside of the immediate organizational unit conducting the study.

Review verification and approval of data before release. An assessment of the methods used to collect, reduce, interpret, characterize, and report project data and results. This assessment is a detailed audit of data recording and transfer, data calculation, documentation procedures, and attainment of data-quality goals (Kulkarni and Bertoni, 1996).

Review (technical) of field and lab methodologies. A qualitative on-site evaluation of measurement and data-collection programs. This review is an assessment of all facilities, equipment, personnel-training programs, and operation, maintenance, calibration, sampling, and analysis procedures (Kulkarni and Bertoni, 1996).

Calibration of field instruments. The process of standardizing field equipment to eliminate bias or systematic errors.

Sample containers certified clean. The practice of cleaning containers methods specific to the contaminants of interest before each sampling round using.

Sample container blanks. Refers to submittal of a sample container that contains a pure, standard solution to the laboratory for analysis to quantify the concentrations of constituents introduced by the container, usually before and after containers have been precleaned (Kulkarni and Bertoni, 1996).

Preservative QA/QC. Refers to any QA/QC processes that evaluate variability, bias, and effectiveness of preservation practices. For example, such QA/QC might include the use of a preservation blank (the practice of preserving a pure, standard solution by using field preservation protocols for laboratory analysis). The purpose is to assess the potential for contamination or attenuation from the preservative chemicals and methods.

Filter QA/QC. Refers to QA/QC processes that evaluate variability, bias, and effectiveness of filtering practices. For example, such QA/QC might include the use of a filter with a pure, standard solution that is filtered exactly as the environmental samples and sent to the laboratory for analysis to check for contamination or attenuation that may result from the filter or filtration process (Floyd, 1996).

Field/trip blank. A field blank is a pure, standard solution taken to the sampling site, exposed to the sampling location(s), and treated exactly like the environmental samples in order to check for analytical artifacts (Kulkarni and Bertoni, 1996; Jones, 1999). A trip blank is a pure, standard solution that is taken to the sampling site, without being exposed to sampling procedures, and transported to the laboratory for analysis in order to estimate contaminants introduced by the sample shipping process (Kulkarni and Bertoni, 1996).

> **Verified blank water**. Refers to the testing of the water that is the source of the pure, standard solution in order to confirm that the pure, standard solution is free of contamination.

Equipment blanks. A pure, standard solution that is passed through the sampling, splitting, or filtration equipment, treated like a sample, and transported to the laboratory as a sample in order to check the cleanliness of the equipment (Kulkarni and Bertoni, 1996; Jones, 1999).

> **Verified blank water.** Refers to the testing of the water that is the source of the pure, standard solution in order to confirm that the pure, standard solution is free of contamination.

Field matrix spike (recovery). A sample prepared in the field by adding a known mass of target analyte to a specified amount of matrix sample for which a corresponding unspiked sample also is available. The spiked and unspiked samples are treated identically in order to determine the effect of the matrix on the method recovery efficiency (Kulkarni and Bertoni, 1996; Jones, 1999).

Field reagent spike (recovery). A sample prepared in the field by adding a known mass of target analyte to a specified amount of reagent sample for which a corresponding unspiked sample also is available. The spiked and unspiked samples are treated identically in order to determine the effect of the reagent on the method recovery efficiency (Kulkarni and Bertoni, 1996; Jones, 1999).

Blind/reference sample (known conc.). A subsample that is submitted for analysis with a composition and identity known to the submitter (usually the field project staff) but unknown to the analyst in order to test the analyst's or laboratory's proficiency (Kulkarni and Bertoni, 1996).

Split replicates—from same sample (unknown conc.). Refers to two or more representative portions taken from a sample or subsample and analyzed by different analysts or laboratories in order to ensure the repeatability of the measurements of interest and test laboratory variability or interlaboratory bias (Kulkarni and Bertoni, 1996; Jones, 1999).

Concurrent replicates—from two samples at same time. Refers to two or more samples collected at the same time that represent the same space location and population. These samples are independently processed through all steps of sampling and measurement in an identical manner to assess variance of the sampling and analysis methodology (Kulkarni and Bertoni, 1996).

Sequential replicates—collected within minutes. Refers to two or more samples collected within minutes of one another and that represent the same space location and population. These samples are independently processed through all steps of sampling and measurement in an identical manner to assess variance of the sampling environment.

Method replicates. Refers to two or more pure, standard solutions that are independently processed through all steps of sampling and measurement in an identical manner to assess variance of the process.

Sampling team replicates. Refers to two or more samples collected by different sampling teams. These samples represent the same population, time, and space location but are independently processed through all steps of sampling and measurement process in an identical manner to assess variance among sampling teams.

Equipment replicates. Refers to two or more samples collected by different sets of equipment of the same type. These samples represent the same population, time, and space location but are independently processed through all steps of sampling and measurement in an identical manner to assess variance of the equipment.

11. QA/QC LABORATORY

Quality-assurance and quality-control (QA/QC) documentation is necessary to assess a data set in terms of data quality, comparability, and legal requirements. QA/QC programs detect and control errors as well as maintain and document the reliability and uncertainty of the data. Requirements for QA/QC programs have increased in the last two decades and now address all aspects of data collection. A properly designed QA/QC program will provide information to evaluate program design, sample collection, sample transport, sample storage, chain-of-custody control, sample analysis, documentation, and data reporting. This section addresses the practices reported for QA/QC in the laboratory. The reviewer should fill out this section only if QA/QC information was given in the report, as indicated by an affirmative response to the QA/QC question in section 2.

Accredited lab. Refers to certification of the laboratory's participation in an external, comprehensive, and documented QA/QC program.

Accreditation. The organization that certifies the analytical laboratory.

Trained professional analysis team. Refers to laboratory personnel who have been properly trained in quality-assurance and laboratory protocols.

Participates in interlaboratory comparison. Refers to participation in a study of results from many laboratories. Possible studies include those conducted by the USEPA Office of Water Supply, the USEPA Office of Water pollution, the Canadian Inland Water, the USGS Branch of Quality Systems (BQS), and the National Oceanic and Atmospheric Administration (NOAA).

External methods / QA/QC audits. Refers to systematic evaluation by an outside organization to determine compliance with operational plans, such as analysis plans and QA program and project plans.

Program. The name of the audit program or the outside organization conducting the audit.

Quality-assurance/quality-control plan. The written plan for use of QA/QC protocols in the laboratory. The laboratory plan is usually predetermined by the laboratory, but the study's objectives define specific data-quality objectives that must be addressed in the laboratory plan.

Published. Refers to whether the report gives a reference for the QA/QC plan.

Reference. This is the reference for the QA/QC plan (if published). "Reference" is an accessibility characteristic.

For each of the following QA/QC procedures, the reviewer can respond with the following choices.

Y (yes). The procedure is mentioned in the report.

N (no). The procedure is not mentioned in the report.

U (unknown). The procedure is part of the published plan for QA/QC, but is not mentioned in the report directly. The published plan may be an agency plan for QA/QC.

Sampling holding period time monitored. The process that confirms that the period of time between sample collection and analysis is within the established time period for storing water samples after collection and preservation without significantly affecting the accuracy of analysis (Parr and others, 1996).

Sampling holding period storage monitored. The confirmation that the samples are stored under conditions that will not significantly affect the accuracy of analysis.

Data entry and validation control. A comparison of data entered for reporting purposes with data from original laboratory sheets completed by analysts.

Instrument calibration. The process of testing and calibrating laboratory equipment to eliminate bias or systematic errors.

Method check (with standards). The process of verifying the effectiveness of laboratory methods by testing samples with known amounts of the analyte. This includes method blanks.

Method check (with replicates). The process of having two or more representative portions taken from a sample or subsample analyzed separately in order to ensure the repeatability of the measurements.

Reagent control. The confirmation, by analysis, of manufacturer certification that the composition of the reagent is of appropriate purity for its intended use.

Blind sample program. The submittal of samples for analysis with a composition and identity known to the submitter (usually a formal laboratory-evaluation organization) but unknown to the analyst to test the analyst’s or laboratory’s proficiency (Kulkarni and Bertoni, 1996).

External blind sample program. A blind sample program is run by an organization outside of the laboratory, an established laboratory-evaluation program outside of the laboratory of interest.

Field/lab QC. Refers to the practice of quality control by the sample collection organization (the field team) for the laboratory organization (the analysis team).

Lab matrix spike (recovery). A sample prepared by the field team by adding a known mass of target analyte to a specified amount of matrix sample for which a corresponding unspiked sample also is available. The purpose is to determine the effect of the matrix on the method recovery efficiency (Kulkarni and Bertoni, 1996; Jones, 1999).

Lab reagent spike (recovery). A sample prepared by the field team by adding a known mass of target analyte to a specified amount of reagent sample for which a corresponding unspiked sample also is available. The purpose is to determine the effect of the reagent on the method recovery efficiency (Kulkarni and Bertoni, 1996; Jones, 1999).

Intralab replicates. Refers to two or more representative portions taken from a sample or subsample and analyzed by different analysts within a given laboratory in order to ensure the repeatability of the measurements and to test laboratory variability (Kulkarni and Bertoni, 1996; Jones, 1999).

12. UNCERTAINTY ANALYSIS/ERROR ANALYSIS

Every measurement has some degree of uncertainty, but it is necessary to know the magnitude and sources of uncertainty to evaluate the quality (accuracy, precision, and repeatability) and the comparability of data and resultant interpretations. Uncertainty/error (U/E) analysis is an estimation of the errors and losses of information inherent in environmental studies that prevent the characterization of exact properties of the underlying distribution (Ward and Loftis, 1983). Documented information that is required to evaluate a given data set by using a U/E analysis may be either specifically or implicitly expressed. All aspects of U/E analysis are comparability characteristics and data-quality characteristics.

U/E specifically expressed. Indicates if a formal uncertainty analysis was documented. The uncertainty of measurement and the resulting calculated or estimated value may be expressed as follows:

- *Significant digits.* The uncertainty in terms of the number of digits used to present data in a report. Reviewers cannot assume that significant figures indicate uncertainties unless this is expressly stated, because an examination of the literature indicates that standards for use of significant figures are not uniformly enforced. For example, if a concentration is reported as 0.125 milligram per liter (mg/L) and the discharge during the same period is reported as 3.0 liters (L), the calculated load would be 0.375 milligram (mg) but should be reported as 0.38 mg because there are only two significant figures in the flow measurement.
- *Population-stats.* Population statistics for reported data will represent the total uncertainty in the measurement and resultant interpretation, but do not differentiate between the uncertainties introduced by natural variability, measurement errors, and interpretive generalizations unless population statistics also are available for quality-assurance and quality-control (QA/QC) data. Documentation of QA/QC data will provide the information needed to differentiate between sources of uncertainties. For example, if an average concentration is reported as 0.125 mg/L with a range from 0.124 to 0.126 mg/L and the average discharge during the same period is reported as 3 L with a range from 2 to 4 L, the calculated load would be 0.375 mg but the load should be reported as 0.4 mg with a stated range of 0.25 to 0.5 mg.
- *Percent-error.* A direct expression of the uncertainty of measurement and resultant interpretation as a function of the absolute value of the reported value. For example, if a concentration is reported as 0.125 mg/L within a measurement error of 10 percent, and the discharge during the same period is reported as 3.0 L within a measurement error of 10 percent, the calculated load would be 0.375 mg but the load should be reported as 0.38 mg within a measurement error of 10 percent.
- *Tolerance (plus or minus).* A direct expression of the uncertainty of measurement and resultant interpretation as an absolute value. For example, if a concentration is reported as 0.125 mg/L within a measurement error of plus or minus 0.001 mg/L, and the discharge during the same period is reported as 3 L within a measurement error of plus or minus 0.3 L, the calculated load would be 0.375 mg but the load should be reported as 0.38 mg within a measurement error of plus or minus 0.04 mg.

U/E implicitly expressed. Indicates that the total uncertainty was not documented by a systematic or formal uncertainty analysis, but the expected accuracy and precision of different types of measurement methods were described. The uncertainty of measurement and the resulting calculated or estimated value may be expressed as follows:

- *Significant digits.* The uncertainty in terms of the number of digits used to present data in a report. Reviewers cannot assume that significant figures indicate uncertainties unless this is expressly stated, because an examination of the literature indicates that standards for use of significant figures are not uniformly enforced. For example, if a concentration is reported as 0.125 mg/L and the discharge during the same period is reported as 3.0 L the calculated load would be 0.375 mg but the load should be reported as 0.38 mg because there are only two significant figures in the flow measurement.
- *Population-stats.* Population statistics for reported data will represent the total uncertainty in the measurement and resultant interpretation, but do not differentiate between the uncertainties introduced by natural variability, measurement errors, and interpretive generalizations unless population statistics also are available for QA/QC data. Documentation of QA/QC data will provide the information needed to differentiate between sources of uncertainties. For example, if an average concentration is reported as 0.125 mg/L with a range from 0.124 to 0.126 mg/L and the average discharge during the same period is reported as 3 L with a range from 2 to 4 L, the calculated load would be 0.375 mg but the load should be reported as 0.4 mg with a stated range of 0.25 to 0.5 mg.
- *Percent-error.* A direct expression of the uncertainty of measurement and resultant interpretation as a function of the absolute value of the reported value. For example, if a concentration is reported as 0.125 mg/L within a measurement error of 10 percent, and the discharge during the same period is reported as 3.0 liters (L) within a measurement error of 10 percent, the calculated load would be 0.375 milligram (mg) but the load should be reported as 0.38 mg within a measurement error of 10 percent.
- *Tolerance (plus or minus).* A direct expression of the uncertainty of measurement and resultant interpretation as an absolute value. For example, if a concentration is reported as 0.125 mg/L within a measurement error of plus or minus 0.001 mg/L, and the discharge during the same period is reported as 3 L within a measurement error of plus or minus 0.3 L, the calculated load would be 0.375 mg but the load should be reported as 0.38 mg within a measurement error of plus or minus 0.04 mg.

IF U/E EXPRESSED. This section includes an array of questions to evaluate how well available uncertainty information documents the uncertainty in reported data.

U/E of how representative is the study site. A documented analysis of data from more than one study site in order to establish that data collected at one site will represent data collected from other, similar sites. This assessment also would define site-to-site variability between sites with similar characteristics.

U/E of field methods. A documented analysis of the precision and bias of data influenced by field-sampling methods.

U/E of field instruments. A documented analysis of the accuracy and precision of measurement instruments. This can be a simple statement of the manufacturer's specifications for accuracy and precision; but, ideally, QA/QC information for the instruments should be published.

U/E of laboratory analysis. A documented analysis of the accuracy and precision of reported values delivered by the laboratory. This can be a simple statement of the laboratory's published QA/QC statistics; but, ideally, information from the project's laboratory and field QA/QC programs should be published.

U/E of stage measurement. A documented analysis of the accuracy and precision of reported stage values. This can be a simple statement of the manufacturer's specifications for accuracy and precision of the stage-measurement system, but at least one independent test should be documented.

U/E of velocity measurement. A documented analysis of the accuracy and precision of reported stage values. This can be a simple statement of the manufacturer's specifications for accuracy and precision of the water-velocity measurement system, but at least one independent test should be documented.

U/E of precipitation measurement. A documented analysis of the accuracy and precision of reported precipitation values. This can be a simple statement of the manufacturer's specifications for accuracy and precision of the precipitation-measurement system, but at least one independent test should be documented.

U/E of calculated results. A documented analysis of the accuracy and precision of calculated values. This is achieved by examining how the uncertainty in input values is propagated by the equations that are used to interpret data.

U/E of model results. A documented analysis of the accuracy and precision of values calculated by a model. This can be a simple statement of diagnostic statistics for the model (such as the R-squared for regression models), but the best indication of model uncertainty is to run the model on a data set that was not used to formulate or calibrate the model.

Other. Can be used to identify other features of stormwater-runoff quality studies that may be documented for analysis of the uncertainty of reported results.

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Dionne and others--METHOD FOR EXAMINATION AND DOCUMENTATION OF BASIC INFORMATION AND METADATA FROM PUBLISHED REPORTS RELEVANT TO THE STUDY OF STORMWATER-RUNOFF QUALITY--OFR 99-254